THE CONDOR

A Magazine of Western Ornithology

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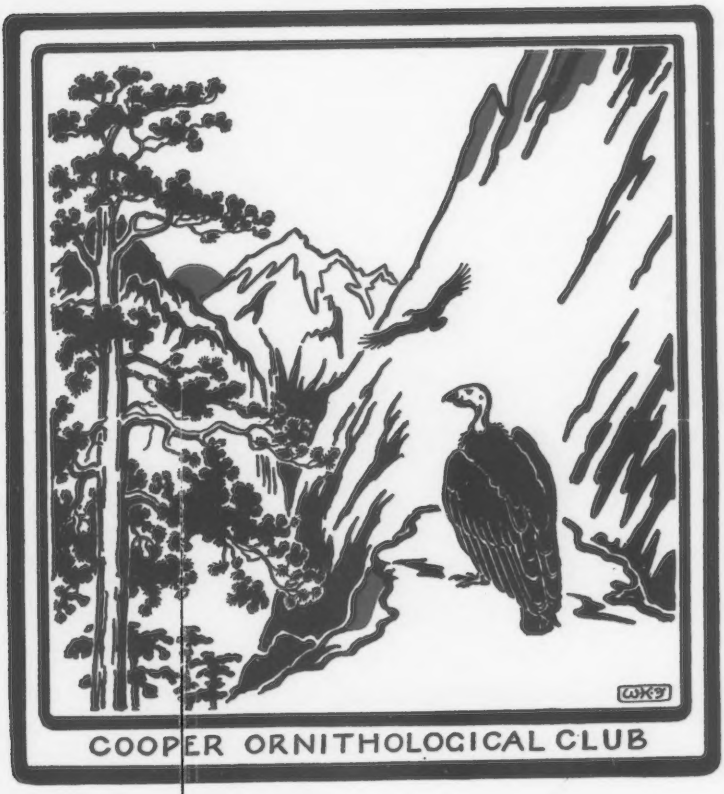

COOPER ORNITHOLOGICAL CLUB

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NOCTURNAL OBSERVATIONS OF ELF OWLS

By LEWIS W. WALKER

From June 8 to 11, 1943, some rather detailed observations of Elf Owls (*Micropallas whitneyi*) were made in the Kofa Mountain Game Refuge, Yuma County, Arizona. A nest hole containing three young, situated about fourteen feet from the ground in a saguaro, was selected for photographic purposes. The cavity was one excavated earlier by a Gilded Flicker. A platform was built approximately five feet below the nest opening, and a six-volt bulb worked from a storage battery was kept burning continuously during the night within five feet of the nest. Within a few hours the pair of birds became accustomed to this illumination and before long even landed on the reflector to catch insects drawn to the light.

In the course of my observations, which amounted to about five hours each night, I failed to see the owls bring to the nest anything but insects, spiders and scorpions. The capture of some of this prey revealed what was, to me, something different in the way of owl behavior. On several occasions one of the birds was seen to fly up into the air and pursue an insect in flight after the manner of a phoebe. This type of hunting was remarkably successful. Both birds also were noticed flying to a near-by century plant bloom. It was too far away for a flashlight to pick up details satisfactorily, so the flower stalk was cut off and brought close to the nest. Here, under artificial illumination, my suspicion of an oriole-type of food-catching was confirmed. Both parents were seen to fly to this plant, hang upside down from a blossom and pick up the night-flying insects that were attracted to the bloom. These gorgeous flowers were common in the region and no doubt the birds flew from one to another taking their pick, cafeteria style.

The Elf Owl's diet, which does not seem to include warm-blooded animals, perhaps has some bearing on the noisy flight of this species. Every other owl which I have observed is practically noiseless in flight. These desert Elf Owls, however, advertised their approach to the nest with swishing wings, and even in total darkness it was easy to tell when one passed a score of feet away.

Another of their flight tactics was somewhat un-owl-like, namely their ability to hover. On three or four occasions one of the birds was standing in the nest doorway when its mate returned with food. The incoming bird would then wait with whirring wings and motionless body until the entrance was clear. From my previous experience with other birds of prey, it seems that most of the insect eaters have this hovering ability to a limited extent. The chief exponents of this type of flight are the Sparrow Hawk, Elf Owl and Burrowing Owl. Their proficiency would seem to rank in the order named.

Some observers have claimed that Elf Owls are at times gregarious. This was very obvious in the Kofa Mountains. During the night following the day on which the blind was constructed, there were four Elf Owls that "cussed out" the human interference.

Fig. 44. Elf Owl with scorpion at entrance to nest in saguaro.

The invasion of a nesting domain by Elf Owls other than the pair that controlled it seemed to pass unnoticed; in fact the presence of the visitors seemed almost welcome. Screech Owls under similar conditions would have had a battle royal. During one of the nights a coyote came down a mountain sheep trail that ran almost under the nest. While this intruder was still several hundred yards away he was convoyed by at least four owls. The pair I was working with took up the escort until he was well into the

Fig. 45. Elf Owl on century plant blossom.

territory of another pair. This convoying seemed to be limited to predatory mammals. The close passage of a deer or a burro on the same night did not arouse any calls of protest.

Natural History Museum, San Diego, California, July 15, 1943.

VARIATION IN WESTERN SPARROW HAWKS

By RICHARD M. BOND

The problem of what to call the sparrow hawks of various parts of the southwestern United States and northwestern Mexico has long been a puzzling one. Names employed in the past are *Falco sparverius sparverius*, *F. s. phaloena*, *F. s. deserticolus* and *F. s. penninsularis*. Descriptions and ranges given by various authors (A.O.U. Check-list, 1910, 1931; Bergtold, 1927; Grinnell, 1914; van Rossem, 1931) have done violence to each other and have usually been of small assistance to the ornithologist who wishes to assign a name to a specimen with some assurance that it actually fits.

In an effort to shed some light on the problem, I have carefully examined and measured 678 sparrow hawks, chiefly from western North America. About 75 additional specimens were examined casually, but are not included in this study because they were too worn or too young, or were molting too heavily to be measured, or because the data were incomplete. In addition, I have used, in one section of this paper, wing measurements of 49 specimens from British Columbia (37 from the Provincial Museum, 12 from the collection of Mr. Kenneth Racey). These measurements were taken for me by Dr. I. McT. Cowan,to whom I offer my sincere thanks. The collections to which the specimens examined by me belong are shown in table 1. To all the owners and curators of these specimens I am extremely grateful for permission to study them and for other assistance. I am especially indebted to Dr. A. H. Miller of the Museum of Vertebrate Zoology in Berkeley and to A. J. van Rossem, Curator of the Dickey Collection in Los Angeles, not only for access to specimens in their care, but for many courtesies and much assistance.

Table 1

	Males	Females	Total
California Academy of Sciences	33	24	57
Donald R. Dickey Collection	56	34	90
Collection of Laurence M. Huey	4	7	11
Collection of Stanley G. Jewett	15	21	36
Museum of Comparative Zoology	39	48	87
Museum of Vertebrate Zoology	133	115	248
United States National Museum	46	34	80
Santa Barbara Museum of Natural History	11	6	17
San Diego Museum of Natural History	26	26	52
Totals	363	317	678

The exact localities at which specimens were collected are not included herewith, since the amount of space that would be needed seems out of proportion to the advantages that might accrue. Distribution by states, provinces, and countries is as follows: Alaska, 1; British Columbia, 22; Alberta, 2; Ontario, 1; Washington, 21; Oregon, 50; California, 234; Baja California (except Guadalupe Island), 142; Guadalupe Island, 13; Idaho, 8; Nevada, 22; Arizona, 72; Sonora, 34; Sinaloa, 1; Nayarit, 3; Guerrero, 13; Montana, 4; Wyoming, 1; Colorado, 5; New Mexico, 4; Kansas, 1; Texas, 3; Nuevo León, 1; Tamaulipas, 1; Puebla, 1; Vera Cruz, 1; Panama, 1; Minnesota, 3; Wisconsin, 2; Indiana, 1; Ohio, 1; Georgia (northern), 2; New York, 2; Connecticut, 2; New Jersey, 2; North Carolina, 1.

This number and distribution of specimens should give a fairly good picture of local variation in the species if there were any assurance that the birds were members of the breeding population where they were collected. Unfortunately, quite the opposite is true, since the majority were taken other than in the breeding season and may have

come from nearly anywhere to the north, or from some distance to the east, west or south. The months in which the specimens were collected are shown in table 2.

Table 2

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
67	35	52	50	**57**	**58**	**57**	52	66	63	51	69

Because sparrow hawks are at least partly migratory, many of these 678 specimens are of little value in a zoögeographical study. Only 8 males and 8 females were reported to be breeding by their collectors, and two of these notations are followed by a question mark. Since these hawks were taken from as far south as Guaymas, Sonora, and Bahia Dolores, Baja California, and as far north as Creston, British Columbia, they cover the ground too thinly to be of much value. I have, therefore, for this study, considered as "breeding" birds or locally hatched young the 172 specimens collected in May, June and July; these are shown in table 2 in bold type. Not quite all of these, however, can safely be used, since five are immature birds in worn plumage and may possibly be non-breeders far from where they were hatched. Although three males in the Dickey Collection (2 intergrades and one *penninsularis*) show that sparrow hawks may breed when less than one year old, and although I should not be surprised to find this to be the prevailing habit in the species, the low survival of immature birds, the incompleteness of collectors' field notes, and the difficulty of distinguishing immature birds that are badly worn, especially females, make it impossible to determine the extent of such breeding from the material examined. Accordingly it was thought best to exclude such specimens. There is also likely to be a small, but entirely undetectable percentage of non-breeding adults from foreign parts. One female, collected in Santa Barbara County, California, May 12, 1930, is so much larger than the other "breeding" birds of southern California that it seems almost certain to be a migrant or non-breeder; it has been eliminated from consideration. Since five of the birds marked as breeding by the collectors have March or April dates, however, the total number of specimens to work with was 171, as follows (some place names shortened or simplified):

Alberta: Fawcett, 1 ♂. Total, 1.

British Columbia: Alberni Valley, Vancouver Isl., 2 ♂ ♂, 1 ♀; Creston, 1 ♂, 1 ♀; Hazelton, 1 ♂, 2 ♀ ♀; Kispiox Valley, 2 ♂ ♂; Stikeen River, 1 ♀. Total, 11.

Arizona: Chiricahua Mts., 1 ♂; Fort Lowell, 1 ♂, 1 ♀; Fort Whipple, 2 ♂ ♂; Huachuca Mts., 1 ♀; Patagonia, Santa Cruz Co., 2 ♂ ♂; Prescott, 1 ♂; Sacaton, Pinal Co., 2 ♂ ♂, 1 ♀; Santa Cruz River, 1 ♂, 1 ♀; 20 mi. S Springerville, Apache Co., 1 ♂, 2 ♀ ♀; 28 mi. S Springerville, 1 ♂, 1 ♀; Tucumcacori, 1 ♂; Tucson, 1 ♂; 37 mi. S Tucson, 1 ♂; Verde, 1 ♂; Whiskey Creek, Tunitcha Mts., 2 ♀ ♀; White Mts., 1 ♂. Total, 26.

California: Bard, Imperial Co., 1 ♂; mouth of Battle Creek, Tehama Co., 1 ♂; Benton, Mono Co., 1 ♂, 1 ♀; Big Pine, 1 ♂, 1 ♀; Bridgeville, Humboldt Co., 1 ♀; Cima, San Bernardino Co., 1 ♂, 1 ♀; Dry Creek, Warner Mts., 1 ♂; Dudley, Mariposa Co., 1 ♀; Eagleville, 1 ♀; 12 mi. S Eagleville, 1 ♂; Gualala, Mendocino Co., 1 ♂; Happy Camp, Siskiyou Co., 1 ♂; Hesperia, San Bernardino Co., 1 ♂; Humphrey's Basin, Fresno Co., 1 ♂; Julian, San Diego Co., 1 ♀; Lake Tahoe, 1 ♀; McKessick Peak, Plumas Co., 1 ♀; Mono Lake, 1 ♂; Owl Creek, Warner Mts., 1 ♂; Palo Verde, Imperial Co., 1 ♀; Panoche, 1 ♂, 1 ♀; Red Rock P. O., Lassen Co., 1 ♀; Riverside, 1 ♂; Ruth, Trinity Co., 2 ♂ ♂; 12 mi. NW Ruth, 1 ♀; San Fernando, 1 ♂; San Francisquito Canyon, Los Angeles Co., 1 ♂; San Gabriel Mts., 1 ♂; San Jacinto Mts., 1 ♂, 1 ♀; San Luis Rey, 1 ♂, 1 ♀; Santa Barbara, 1 ♂; Squaw Creek, Warner Mts., 2 ♀ ♀; Susanville, 1 ♂; Trout Creek, Tulare Co., 1 ♂; Ventura, 2 ♀ ♀; Visalia, 1 ♀; Walker Pass, Kern Co., 1 ♂; White Mts., Mono Co., 3 ♂ ♂; White Mts., Inyo Co., 1 ♂. Total, 50.

Idaho: Coeur d'Alene, 1 ♂, 1 ♀; Twin Falls Co., 1 ♀. Total, 3.

Montana: Forsythe, Rosebud Co., 1 ♀; Missoula Co., 1 ♀; Powder River Co., 1 ♂; Rosebud Co., 1 ♂. Total, 4.

Oregon: Adel, Lake Co., 1 ♂; Anthony, Baker Co., 1 ♀; Dufur, Wasco Co., 1 ♀; La Grande, 2 ♂ ♂; Lakeview, 1 ♂; Portland, 2 ♂ ♂, 1 ♀; Prineville, 1 ♀; Swan Lake, Klamath Co., 1 ♂, 1 ♀; Wallowa Co., 1 ♀. Total, 13.

Nevada: Charleston Mts., 1 ♀ ; Dyer, Esmeralda Co., 1 ♂, 1 ♀ ; Jefferson, Nye Co., 1 ♀ ; Pine Forest Mts., 1 ♂ ; Pyramid Lake, 2 ♂ ♂ ; Head Reese River, Toyabe Mts., 1 ♂ ; Sharp, Nye Co., 1 ♂, 1 ♀ ; Smoky Creek, Washoe Co., 1 ♀ ; Truckee Valley, 1 ♀. Total, 12.

New Mexico: West side San Luis Mts., Hidalgo Co., 1 ♀. Total, 1.

Washington: Clallam Co., 1 ♂ ; Keechelus, Kittitas Co., 1 ♂ ; Tacoma, 1 ♂ ; Wahkiakum Co., 1 ♂. Total, 4.

Baja California: Because many of the place names used by collectors have gone out of use, or have been misspelled, or are duplicated in various parts of the state, the approximate latitude of each locality (usually correct to the nearest half degree) is given herewith. Agua Caliente (23° 30′), 1 ♂, 1 ♀ ; Cañon San Juan de Dios (30°), 1 ♀ ; Carmen Island (26°), 1 ♀ ; Dolores Bay (25°), 1 ♂ ; Ensenada (32°), 1 ♂, 1 ♀ ; 20 mi. E Ensenada, 1 ♀ ; Guadalupe Island (29°), 6 ♂ ♂, 7 ♀ ♀ ; La Grulla (31°), 1 ♂, 3 ♀ ♀ ; La Paz (24°), 1 ♀ ; Miraflores (23° 30′), 1 ♀ ; Nachogüero Valley (32° 30′), 1 ♂, 2 ♀ ♀ ; San José (31°), 1 ♀ ; San José del Rancho (24°), 1 ♂ ; San Ignacio (27° 30′), 1 ♂ ; San Quentín (30° 30′), 1 ♂ ; Santa Rosalía Bay (28° 30′), 1 ♀ ; 10 mi. S Santa Rosalía (27°), 2 ♂ ♂ ; 40 mi. W Santa Rosalía (27° 30′), 1 ♂ ; Santo Tomás (31° 30′), 1 ♂ ; San Ysidro Ranch (32° 30′), 1 ♀ ; Tecate Valley (32° 30′), 1 ♂, 1 ♀ ; Triunfo (24°), 1 ♂. Total, 43.

Sonora: Guaymas, 1 ♂, 2 ♀ ♀. Total, 3.

This would be a better sample if it were more evenly distributed, but seemingly much collecting is done when the weather is nice. Hence collecting in the north (where the problem is less difficult) has been done in the summer, and in Mexico and the southwestern United States mainly in the winter. Thus, although I have examined 55 specimens from continental Mexico (exclusive of Baja California) only three (those from Guaymas, Sonora) are breeding birds.

Color and pattern.—These features were closely observed in all the specimens examined, and Mearns' remarks (1892) upon their extreme variability were abundantly confirmed. Such conclusions as could be drawn will be given later, except for the following major generalization: The individual variation is so great and so complicated by fading and wear, and overlap of characters of populations from various regions is so complete and the means so close, that with the exception of the birds from Guadalupe Island, Baja California, color and pattern are of no value in distinguishing western races of sparrow hawks.

Dimensions.—Measurements taken of the specimens were: wing length, tail length, chord of culmen (including cere), depth of upper mandible at anterior margin of cere, length of tarsus, and length of middle toe without claw. These measurements are of very different value.

Wing length.—This measurement is probably the most reliable. I have used extreme length, rather than chord, because the way the skins are made up and the slight curvature of the feathers makes this method of measuring easier in this species, and the results are more strictly comparable as between specimens. The skins were classified by eye into four stages of wear, such that I judged the most worn group to have lost about 2 mm. of wing length; specimens more worn than that were not used. Skins collected at all seasons from British Columbia, Washington, Oregon, and northern California (a reasonably homogeneous group) were compared statistically by wear groups, and the groups were not found to differ significantly. However, because actual wear could be seen, the measurements found for the most worn specimens have been extended by 1 mm. in the records and calculations. This has the effect of still further reducing an already insignificant difference.

Tail length.—This measurement is much less reliable than wing length for two reasons. Wear is much greater and more irregular, occurring, for example in young in the nest before the feathers are fully grown in. Adults in the nesting season, that are otherwise in fair condition, often show extreme tail wear, perhaps from incubating in a small cavity. At any rate, the tails of only about half the specimens show little enough

wear to be worth measuring. Also, it is usual for collectors to cut across the tail when preparing specimens, and this cut is often made to include the basal ends of the quills. This practice appears to result in a considerable difference in the amount of shrinking of soft tissues in different skins, with a consequent difference in the amount of quill exposed. The only reason that the measurement was taken with such care is that Mearns (1892) used it in his diagnosis of *F. s. deserticolus*. There is a significant positive correlation between wing and tail lengths, but the tail lengths are more variable than the wing lengths.

Beak.—In the hawks, especially in the falcons, adequate measurements of the bill are practically impossible to take, largely because slight differences in wear in bills of this shape make for relatively great differences in the measurements and also because of the difficulty in locating accurately the basal point of the culmen. Mearns apparently excluded the cere in this measurement, but there is considerable difference in the shrinkage of that structure and hence, in some skins, of the amount of culmen exposed.

Tarsus and middle toe.—The accuracy of the measurement of the tarsus depends partly on the make of the skin, and that of the middle toe can only be taken if the toe is straight. How straight is "straight" depends all too much on how the measurer happens to decide at the moment.

Weights.—Ninety-three of the specimens were weighed by their collectors, but only 28 of the "breeding" birds were weighed. Because falcons weigh less, as a rule, in the summer during the breeding and molting seasons, and because a sparrow hawk can, and sometimes does, cram into its crop and stomach nearly 50 gm. of food at a meal, only weights taken at the same season and with the gut emptied before weighing would be strictly comparable. A captive female I had weighed 130 gm. empty and 179 gm. after a gorge. About all that these weights show is that birds with long wings averaged heavier. This was determined by plotting weights against wing lengths. The regression coefficients were not calculated.

There is considerable sexual difference in the size of sparrow hawks; accordingly the sexes must be considered separately. It was feared that there might be a significant difference between immature and adult birds of the same sex. (I use the term "immature" to mean a bird of the year in which feather growth has been completed, and "juvenile" to indicate a bird in which remiges and rectrices are still growing.) Statistical analysis of specimens from the same area used in checking on the wear groups showed this not to be the case. This is fortunate because many of the specimens cannot be assigned to either age group with any degree of certainty. This difficulty is most marked in birds from southern Baja California, where in some cases only the stage of growth of the feathers serves to distinguish juveniles from adults.

References on statistical methods.—In applying the methods and formulae of statistical analysis to this study, the texts of Bruce and Schumacher (1935), Fisher (1935), Snedecor (1937), and Simpson and Roe (1939) were used. The reader, if unfamiliar with the terminology, may refer to one of these standard sources.

Falco sparverius sparverius

Synonyms: F. s. phaloena (Lesson) (1845, col. 1087). The possibility of ever determining what Lesson had in hand seems hopeless. The description is clearly of some subspecies of sparrow hawk, but subspecific characters are lacking. The total length (24 cm.) is the only measurement given. Only the male is described. Where and when the type specimen was taken are not stated. If it came from San Blas ("San-Blases" according to Lesson), it might conceivably be *penninsularis*, although it is not known at present how far south of Sonora this race occurs. There are two towns of that name on the Mexican coast between Sonora and Acapulco. The second locality mentioned, Acapulco, is outside the breeding range of sparrow hawks, so that if the type was collected there, it must have been a wintering *F. s. sparverius*. Even if it should be discovered that sparrow hawks breed at either

of the towns of San Blas, without the date, type specimen or a more exact description, it would be impossible to guess whether the name was applied to the local race or to the migrant one. A. J. van Rossem informs me that so far as he has been able to discover, Lesson's type no longer exists; accordingly, the status of the name *phaloena* must be indeterminable, probably a synonyn of *sparverius*.

F. s. deserticolus Mearns (1892:263). This is clearly a synonym of *F. s. sparverius*. See discussion beyond and in section on intergrades.

Variations in size.—From the study of specimens and their measurements, it eventually became clear that the birds of Alaska, British Columbia, Washington, Oregon, Idaho, at least the northern two-thirds of Nevada, California west of the Mojave and Colorado deserts, and Baja California west of the Sierra Juárez and Sierra San Pedro Martír and south on the Pacific coast to about lat. 30° 30′ N. were a generally homogeneous group. The measurements of the specimens from this area are shown in table 3.

Table 3

Falco sparverius sparverius from western North America

Measurement	Number of specimens	Observed limits	Arithmetic mean	Standard deviation*	Coefficient of variation
Wing length ♂ ♂	54	181-200	187.79 ± .57	4.24 ± .44	2.26 ± .22
Wing length ♀ ♀	44	188-206	196.43 ± .73	4.87 ± .52	2.48 ± .26
Tail length ♂ ♂	7	116-125	119.38	....	....
Tail length ♀ ♀	7	116-131	122.14	....	....
Chord of culmen ♂ ♂	45	13.1-15.7	13.94 ± .09	.57 ± .06	4.08 ± .43
Chord of culmen ♀ ♀	37	13.0-15.3	14.47 ± .10	.60 ± .07	4.17 ± .49
Depth of upper mandible ♂ ♂	45	5.6-7.5	6.46 ± .06	.37 ± .04	5.75 ± .61
Depth of upper mandible ♀ ♀	38	5.9-7.4	6.58 ± .06	.38 ± .04	5.84 ± .67
Tarsus ♂ ♂ and ♀ ♀	45 ♂ ♂ + 43 ♀ ♀	38-44	41.11 ± .15	1.37 ± .10	3.33 ± .25
Middle toe ♂ ♂ and ♀ ♀	20 ♂ ♂ + 26 ♀ ♀	21-26	23.78 ± .15	1.04 ± .11	4.36 ± .46

*Standard deviation and standard error are used throughout. The formula $\sigma = \sqrt{\frac{\Sigma d^2}{N-}}$ for the standard deviation was used in all cases. All significant decimals were used in calculation, but the figures are rounded to two places in the tables.

The wing measurements and the statistical constants derived from them mean that about 68 per cent of the males have wing lengths between 183.55 and 192.03 mm., and that over 95 per cent fall between 179.31 and 196.27. Corresponding figures for the 44 females are: $M \pm \sigma = 191.56–201.30$ and $M \pm 2\sigma = 186.69–206.17$. It will be seen that the females are not only larger than the males, but are more variable as well.

The tail lengths given in the table are too few and too variable to mean anything. However, 66 fresh fall and winter males from the same area (some doubtless migrants from the north) were measured with the following results: $M = 120.02$, $\sigma = 5.15$, $V = 4.29$. The correlation coefficient between wing length and tail length of these specimens was $r = .55$, which is significant (that is, a bird with long wings is likely to have a long tail). The regression coefficient of tail length on wing length was .48, from which it can be shown that the tail length of the "average sparrow hawk" for this group can be found by the equation:

$$\text{Tail length} = 29.68 + .48 \text{ (wing length)}.$$

The relative length of the tail (as compared to the wing) in males does not differ significantly from that of the females, nor from what is found in the other races.

There is no significant difference in the length of tarsus or length of middle toe as between subspecies, areas, or sexes in the region treated here. A few specimens of *F. s. paulus* that were measured out of curiosity in the course of this work seemed to have smaller feet than the western birds.

With respect to wing length, the 54 "breeding" males from the area outlined above were compared statistically with the 22 males available to me from the eastern United States and Canada (excluding those from Florida and southern Georgia). The measure-

ments of these latter were: $M = 186.32 \pm 1.10$; $\sigma = 5.18 \pm .78$; $V = 2.78 \pm .42$. The difference of the means is only 1.47 mm., and this divided by its standard error is only 1.29, which is far from significant. In other words, there is no indication that the eastern and western samples did not come from the same homogeneous population. I had available only six eastern females which also do not differ significantly from those

Fig. 46. Size variation in *Falco sparverius sparverius*. Positions of lines are approximate (see text).

of the west. Since I cannot see any other difference between the eastern and western sparrow hawks, I conclude that the current allocation of birds from California and northward to *F. s. sparverius* is entirely correct.

The boundaries of this western area of homogeneity were arrived at by separate examination of breeding specimens from various sub-areas, such as the Northwest Coast, Columbian Plateau, Great Basin, Sacramento-San Joaquin Valley, and Southern Coastal California, and it at first appeared that specimens from the north averaged larger than those from the south. The cline of average wing length, however, does not

bear a simple relation to latitude except in the southern half of California, where the correlation is striking. It seems impossible with the specimens available to describe the situation in mathematical terms. A rough approximation of the size variation is given on the map (fig. 46) where distribution of size groups is shown. It should be clearly understood that study of more and better distributed specimens might lead to considerable shifting of the lines on the map, and that I have not meant to indicate that the difference between the "very small" and "small" birds is the same number of millimeters (or the same fraction of σ) as between any other two adjacent groups shown.

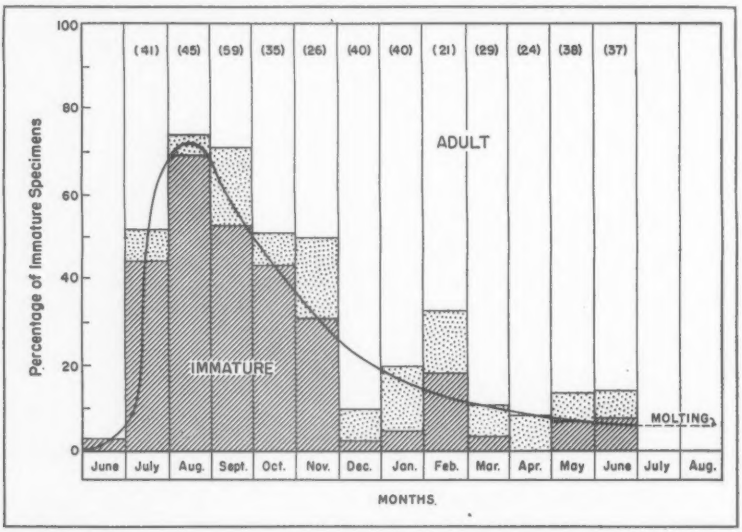

Fig. 47. Percentage of immature *F. s. sparverius* in total population by months. Left-hand June column shows birds fledged in current season; at right, June survivors from previous year. Dotted areas indicate birds of doubtful age, the majority of which are probably immatures. Figures in parentheses indicate number of specimens.

It appears that the line between "medium" and "large" sparrow hawks approximates the line separating the regular migrants, to the northeast, from those partly or completely non-migratory, to the southwest. And it might seem that these differences in size and migratory habits would be a suitable basis for separating another subspecies, comparable to the separation of *Zonotrichia leucophrys pugetensis* from *Z. l. nuttallii*. This I think is emphatically not the case. In the first place, the size difference of the sparrow hawks is one of *means*. The individual size variation is enormous, and overlap is complete or practically so. In the second place, migration in sparrow hawks is no such regular matter as in the sparrows and the line between migrants and non-migrants this year is probably a very poor guide to where it will be next year when food supply and weather may be quite different.

Plumages.—I can see no evidence that any fall molt of the young takes place. All changes in appearance are attributed to wear and fading. Immature specimens are not always certainly distinguishable even in fresh plumage; the most useful criteria of immaturity are: (a) heavier spotting on the underparts, the spots being longer and occurring higher on the breast; (b) breast feathers of downier consistency (before be-

coming worn); (c) heavier barring on the back; (d) wider and paler tips of the primaries (before excessive wear). A useful, though less reliable, criterion is the presence of dark shaft streaks in the crown patch. Immature females are much more difficult to distinguish than immature males.

Longevity.—First-year birds disappear rapidly after reaching a peak of about two-thirds of the population in August. This is shown in figure 47. Specimens taken in spring are too few and the immatures too difficult to distinguish in worn plumage for the figures to be conclusive, but it appears that about 11 to 17 per cent of the young produced reach adulthood. The average life expectancy of sparrow hawks one year old is about 8.3 to 12.5 more years.

Migration.—Comparison of specimens taken at various times of the year in some areas shows clearly the fact of migration. Specimens from the area comprising all of Arizona and the California counties of Santa Barbara, Ventura, Los Angeles, San Bernardino and those to the south were grouped by months. There were not enough specimens taken in several of the months to give reliable results, and the variations in parts of the area in which the birds were collected makes the figures still less reliable. However, by averaging the wing lengths by seasons, these difficulties were largely obviated. The results (fig. 48) for the 120 males were (numbers in parentheses are numbers averaged): summer (May, June, July and August) (33), 184.18; fall (September through December) (44), 188.02; winter (January and February) (25), 183.60; spring (March and April) (18), 187.56. For the 67 females the results were: summer (15), 189.33; fall (25), 194.56; winter (12), 193.42; spring (15), 194.67. My interpretation of this is that the resident breeding population is greatly augmented in the fall by larger migrants from the north, many of which, however, have left the area and gone still farther south by late winter. In March and April the surviving migrants have returned on their way north, and by May practically all have left the area. The chart makes it appear that the females and males have somewhat different migrational habits. Actually this evidence is spurious and mainly a result of the small size of the samples and partly of the geographical distribution of the individual specimens. There were not enough specimens for all months from either the southern part of the range of *sparverius* or from southern Arizona to make use of a more homogeneous breeding area, but I have no doubt that the general effect would be the same. (Note: a similar migration curve is shown by Allan and Sime (Wilson Bull., 55, 1943:29-39).)

According to Bent (1938), the species breeds as far north as Alaska and Mackenzie but does not winter north of southern British Columbia. In British Columbia, Washington, Idaho, Oregon, northern California, and northern Nevada, and even farther south, there is a noticeable migratory movement in fall and early winter. In southern California there is a marked increase in numbers of sparrow hawks at this season that is obviously caused by an influx of wintering and migrant birds from the north, and I have observed the same phenomenon in Arizona and Sonora.

Generally speaking, species of western birds that have been intensively studied show a tendency for the northernmost populations to migrate farthest south in winter (Swarth, 1920; Blanchard, 1941; Miller, 1941) passing over the southern and less migratory, or resident populations. Although there are exceptions to this rule, it may be at least a fair guess as to what sparrow hawks do.

It thus appears likely that *F. s. deserticolus* of Mearns and many birds marked "*F. s. phaloena*" in collections are in truth only migrants from Canada. Because of the faded condition of a large proportion of the large immature specimens taken in Arizona and Sonora in fall and early winter, I suggest the possibility that they were hatched perhaps as far inland as the area east of the Rockies, where insolation is greater than

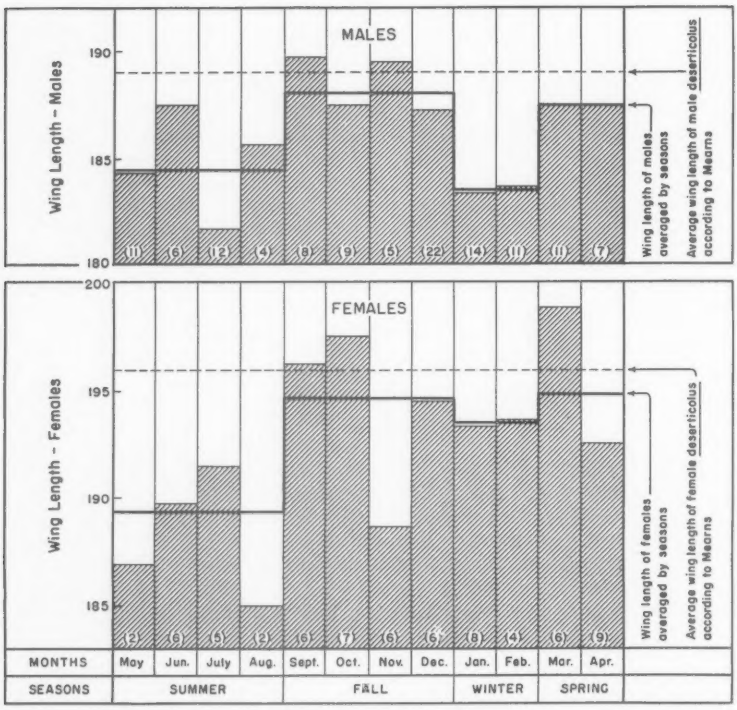

Fig. 48. Average wing lengths of sparrow hawks from Arizona and southern California. Shaded columns, averages by months; heavy line, averages by "season." Numbers in parentheses indicate numbers of specimens.

in most of the area to the westward. Faded adult specimens taken in Arizona and Sonora from January through May, of course, may have faded in their winter habitat.

Falco sparverius penninsularis

Nine males and eight females clearly assignable to this race have been examined. These were collected in May, June or July in Baja California at points from Cañon San Juan de Dios (about lat. 30° 05′ N.) south to the Cape District and from Isla Carmen in the Gulf of California. Three breeding specimens from Guaymas, Sonora, also fall well within the size range of this subspecies. On the basis of this and other evidence to be discussed beyond, I believe that the breeding range of *penninsularis* is approximately as follows: Coastal (within about 50 km. of the Gulf) and southern (south of Guaymas) Sonora, and all of Baja California south of latitude 30° 05′ N., and the area north of that line that lies east of the Sierra Juárez and the Sierra San Pedro Martír (see map, fig. 49). For convenience, part of the north boundary of the range is taken as the United States-Mexico line, which it must in fact very closely approximate.

South of 30° 05′ N., on the basis of the sample available to me, no cline of any sort could be distinguished, and the population appears to be perfectly uniform, or perhaps it would be better to say equally variable everywhere.

The measurements of these 17 specimens, and their statistical functions, are shown in table 4. It will be observed, as regards wing length, that $M + 2\sigma$ of *penninsularis* (males 178.04, females 186.77) is less for males than $M - 2\sigma$ of *sparverius* (males 179.31, females 186.69), and that the figures barely overlap for females. Thus, theoretically, less than three per cent of the males and less than six per cent of the females of each subspecies overlap the other and are indistinguishable. That is, if 100 male specimens of *sparverius* were mixed with 100 of *penninsulars*, 197 or more could be separated and correctly named on the basis of wing measurements, and only 1.5 per cent or less (3 per cent or less of females) of the birds would be unassignable.

Table 4

Falco sparverius penninsularis

Measurement	Number of specimens	Observed limits	Arithmetic mean	Standard deviation	Coefficient of variation
Wing length ♂ ♂	9	164-175	169.22 ± 1.47	4.41 ± 1.04	2.61 ± .62
Wing length ♀ ♀	8	166-182	175.75 ± 1.95	5.51 ± 1.38	3.14 ± .78
Tail length ♂ ♂	1		114	....	....
Tail length ♀ ♀	3	102-113	107.67	....	....
Chord of culmen ♂ ♂	7	13.6-15.0	14.43 ± .19	.51 ± .14	3.51 ± .94
Chord of culmen ♀ ♀	7	13.2-16.2	14.46 ± .38	1.01 ± .27	7.00 ± 1.87
Depth of upper mandible ♂ ♂	7	6.3-7.0	6.70 ± .11	.30 ± .08	4.40 ± 1.18
Depth of upper mandible ♀ ♀	6	6.3-7.1	6.70 ± .12	.30 ± .09	4.53 ± 1.31
Tarsus ♂ ♂ and ♀ ♀	9 ♂ ♂ + 7 ♀ ♀	38-43	40.31 ± .37	1.50 ± .27	3.71 ± .66
Middle toe ♂ ♂ and ♀ ♀	2 ♂ ♂ + 5 ♀ ♀	22-26	23.86 ± .48	1.26 ± .33	5.30 ± 1.42

Among the 315 sparrow hawks from within the western part of the breeding range of *F. s. sparverius*, 10 or 3.15 per cent are smaller than $M + 2\sigma$ of *penninsularis*. (One of the 10, from northwestern Baja California, may actually be an example of *penninsularis* that wandered 75 or 80 miles out of its breeding range.) These figures compare very well with the < 3 per cent for males and < 6 per cent for females expected from statistical theory.

Fifteen fresh males (all seasons) from Baja California had a correlation coefficient between wing length and tail length of $r = .72$; regression of tail length on wing length of .886, giving the formula:

$$\text{Tail length} = .886\ (\text{wing length}) - 42.06$$

This, compared with *sparverius* seems to show that *penninsularis* is relatively as well as actually shorter tailed, but the difference between the regression coefficients divided by the standard error of the difference is only 1.14, which is far from significant.

The collecting localities of males and females with wing length equal to or less than the mean of *penninsularis*, between M and $M + \sigma$, and between $M + \sigma$ and $M + 2\sigma$ were plotted on a map (not reproduced because of its undue complexity), and it is on the basis of this map in addition to evidence from the breeding specimens from Guaymas, Sonora, and those from Baja California that the breeding range of *penninsularis*, as given above, was worked out. It would appear to be relatively safe to assign any male sparrow hawk with a wing length of 178 mm. or less, taken in the indicated breeding range at any time of year, and any female similarly taken, with a wing length of 186 mm. or less, to *F. s. penninsularis*.

Some specimens of this race can be identified as immature by the same criteria which apply to *F. s. sparverius*, but the differences between immature and adult specimens of *penninsularis* are much less well marked on the average. The fluffy texture of the breast feathers of immature birds seems to be the most reliable criterion for specimens in fresh plumage, but it is not of much use except in fall and late summer. About

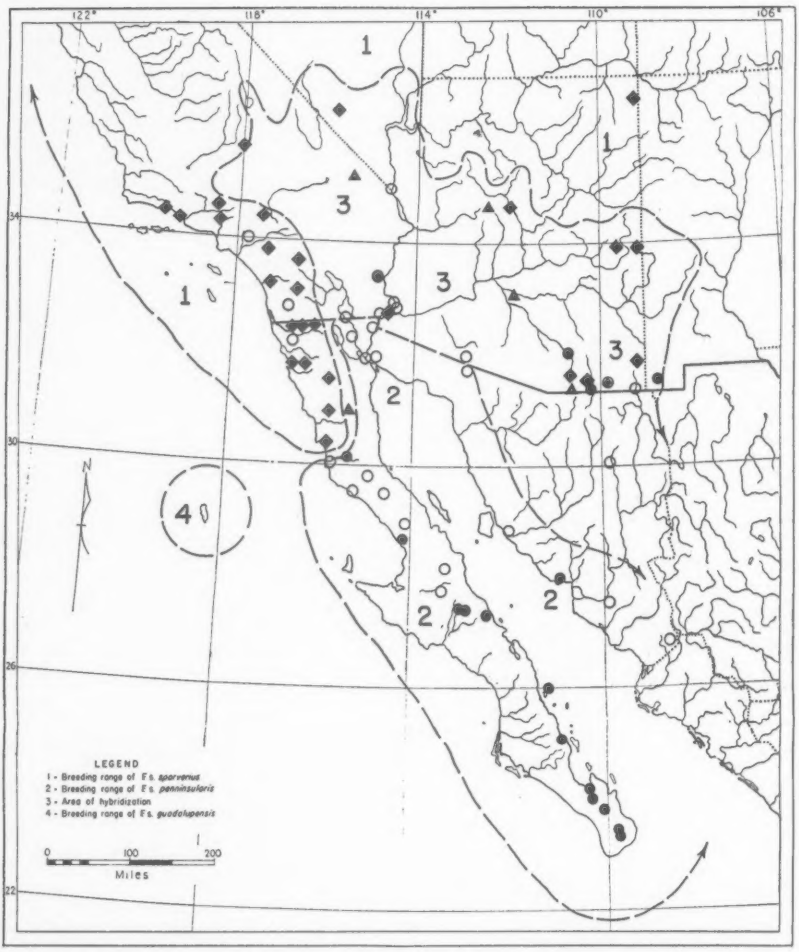

Fig. 49. Distribution of races of *Falco sparverius* in southwestern United States and northwestern Mexico. Diamonds, specimens in size range of *F. s. sparverius* taken in breeding season; dots, specimens in size range of *penninsularis* taken in breeding season; triangles, specimens in size range of both *F. s. sparverius* and *penninsularis* taken in breeding season; circles, specimens in size range of *penninsularis* taken other than in breeding season.

half the birds which were not yet fully fledged (not listed above) could have passed as adults had they been collected a few months later than they were.

There appears to be no consistent color difference between *F. s. sparverius* and *F. s. penninsularis*. Plumage of juveniles and fresh-plumaged immature specimens and the newly grown feathers of molting adults of *penninsularis* appear to average just as dark and just as red as in *sparverius*. So far as I can see, the usual paleness of specimens of

the southern race is entirely due to rapid and extreme fading. There are, however, average pattern differences, in that *penninsularis* has a smaller crown patch, less heavy barring on the back, less extensive spotting beneath, but not, as was reported by Mearns (1892), less complete dark barring of the webs of the primaries. There is complete overlap of these characters, however, and the average differences are too slight to be of value in assigning individual specimens to races. The "yellow iris" reported for this race by Mearns on the basis of Xantus' notes has not been seen since by collectors I have interviewed (A. J. van Rossem, Laurence Huey), nor has it been recorded in the field notes of other collectors to which I have had access (J. Grinnell, Chester Lamb), or on specimen labels I have seen. Probably Xantus was careless either in his observation or in writing his notes or labels.

As is the case with so many other birds, I suppose that there may be some post-breeding wandering of *F. s. penninsularis* to points outside the actual breeding range, but I would expect such movement to be relatively small. I know of no evidence to suggest that the subspecies is migratory in the slightest degree.

GUADALUPE ISLAND

The sparrow hawks of Guadalupe Island have long been known as ***Falco sparverius phaloena*** (= *deserticolus*) (see Thayer and Bangs, 1908; Grinnell, 1928) and quite reasonably so, since they fulfill Mearns' (1892) description remarkably well, by being large and pale (actually, in large part, faded). Since, however, *deserticolus* is a synonym of *sparverius* and the name *phaloena* is not assignable certainly to any subspecies, it has seemed desirable to re-examine this isolated population. On the bases of size, color, and insularity, I conclude that the Guadalupe Island birds should be separated from other named races, and I propose to call them

Falco sparverius guadalupensis, new subspecies
Guadalupe Island Sparrow Hawk

Type.—Adult male, no. 306169 Museum of Comparative Zoology; Guadalupe Island, Baja California, Mexico, June 10, 1906; collected by W. W. Brown.

Subspecific characters.—Size large, equal to *sparverius* from central British Columbia; appreciably larger than *sparverius* in northwestern Baja California and the southern half of California; much larger than *penninsularis*. The light collar in both sexes is relatively lighter than in *sparverius* or *penninsularis*; this appears to be more consistently true of the adults than of the immature specimens. The beak is relatively small.

I have been able to examine only 13 fully grown specimens of this race. These are five worn adult males, one immature male, one worn adult female, and six immature females. There is in addition a juvenal female on which the color of the collar could be examined. Since I have seen no fresh adults of either sex, I cannot give specific colors that are of any diagnostic value. However, it is possible to separate sparrow hawks, with reasonable success, into about five categories depending on the relative depth of color of the collar, compared to the ground colors of the breast and back. These classes are as follows (see fig. 50):

Class 1. Sections 1, 2 and 3 of collar as pale as ground color of breast.

Class 2. Section 1 as pale as ground color of breast; sections 2 and 3 distinctly paler than ground color of back.

Class 3. Section 2 of collar about as dark as ground color of back; sections 1 and 3 distinctly paler.

Class 4. Sections 2 and 3 about as dark as ground color of back; section 1 distinctly paler.

Class 5. Sections 1, 2 and 3 of collar about as dark as ground color of back.

On this basis, comparisons of the adults of *guadalupensis* with the neighboring populations are shown in table 5, the class numbers being treated as though they were measurements.

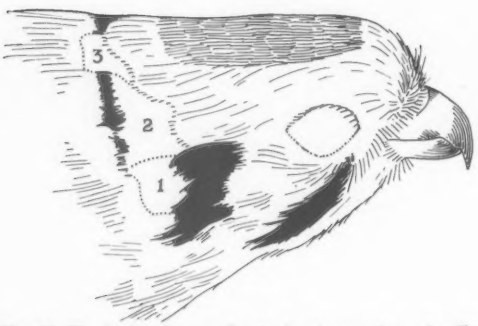

Fig. 50. Head of a sparrow hawk showing sections of collar referred to in text and in table 5.

Table 5

Comparison of collar color of *F. s. guadalupensis* with other populations of sparrow hawks

Measurement	Number	Mean	Standard deviation	Coefficient of variation
1. Worn adult *guadalupensis*	6	1.50 ± .35	.87 ± .25	57.73 ± 16.67
2. Worn adult *penninsularis*	29	3.66 ± .22	1.18 ± .16	32.29 ± 4.24
3. Worn adult *sparverius* from SW California and NW Baja California	25	3.88 ± .16	.80 ± .11	20.67 ± 2.92
4. Worn adult topotypes of "*deserticolus*" (Arizona and SE California)	16	3.50 ± .28	1.10 ± .20	31.51 ± 5.57

Difference of means of 1 and 2 divided by standard error of the difference = 4.25
Difference of means of 1 and 2 divided by standard error of the difference = 6.40
Difference of means of 1 and 2 divided by standard error of the difference = 4.00

Although classification into groups by collar color is rather subjective, I think that the differences of the means of the adults are significant. In the fresh immatures, the differences are less well marked, although *guadalupensis* has the palest collar (mean = 2.50). The seven immature *penninsularis* averaged 2.57, which is not significantly different, and the 10 *sparverius* from the opposite mainland had a mean of 3.20. This last may be significantly different. There were not enough fresh, immature topotypes of "*deserticolus*" to make a comparison.

The nearest point of the mainland of Baja California is almost exactly 135 miles from Guadalupe Island in a direction slightly north of east. The San Benito Islands are slightly farther south of east. San Clemente Island off California is about 240 miles due north. A sparrow hawk over the mainland shore would have to be over 4000 feet in the air under ideal atmospheric conditions even to see Guadalupe Island. Although this distance is easily within the powers of flight of a sparrow hawk, it seems to me most improbable that northern sparrow hawks regularly find the island from the mainland and winter there, or that birds from the adjacent mainland regularly visit it. On the other hand, the large size of the endemic race makes it seem possible that it was originally colonized by large, migrant birds from far to the north rather than by smaller, non-migratory individuals from the adjacent mainland.

The measurements of the birds from Guadalupe Island are given in table 6. The greater apparent variability of the males as shown by σ and V of the wing lengths is probably caused by the presence of one small (wing length = 180 mm.) individual in this small series. The usefulness of all the measurements for such small samples as are here shown is limited, but there is no question that *guadalupensis* is a large subspecies.

Although it is not very different in wing length from the mean of western *F. s. sparverius*, it is considerably larger than the *sparverius* from the nearest part of the range of the latter, which is the area marked "very small" on the map (fig. 46). Seventeen "very small" male *sparverius* have a mean wing length of 185.94 mm., or 3.39 less than in *guadalupensis*; the mean of 10 "very small" females is 194.50, or 2.21 less than in *guadalupensis*.

Table 6

Falco sparverius guadalupensis

Measurement	Number of specimens	Observed limits	Arithmetic mean	Standard deviation	Coefficient of variation
Wing length ♂ ♂	6	180-196	189.33 ± 2.67	6.63 ± 1.91	3.50 ± 1.07
Wing length ♀ ♀	7	193-202	196.71 ± 1.36	3.61 ± .94	1.84 ± .49
Tail length ♂ ♂	1	121	121	....	....
Tail length ♀ ♀	5	116-129	120.6	....	....
Chord of culmen ♂ ♂	5	13.3-14.3	13.74 ± .19	.42 ± .19	3.03 ± .96
Chord of culmen ♀ ♀	7	13.3-14.9	14.33 ± .19	.51 ± .14	3.58 ± .96
Depth of upper mandible ♂ ♂	5	5.8-6.6	6.20 ± .17	.38 ± .12	6.14 ± 1.94
Depth of upper mandible ♀ ♀	7	5.9-6.6	6.17 ± .09	.23 ± .06	3.73 ± 1.00
Tarsus ♂ ♂ and ♀ ♀	5♂ ♂ + 7♀ ♀	40-44	41.58 ± .44	1.52 ± .31	3.64 ± .74
Middle toe ♂ ♂ and ♀ ♀	4♂ ♂ + 5♀ ♀	23-26	24.11 ± .26	.78 ± .11	3.25 ± .77

INTERGRADES

In an area comprising the Colorado and Mojave deserts, the whole watershed of the Gila River and its tributaries (at least as far east as the New Mexico line), and south at least to the Mexican boundary, the breeding sparrow hawk population is extremely variable. Southern Nevada probably should be included also, but I have seen but one summer-taken specimen from there. In this area there occur individuals of sizes typical of both *sparverius* and *penninsularis* as well as many birds close to the range of overlap of the two subspecies (see map, fig. 49). This is apparently a real area of general mixing, and not a case of either overlapping of ranges of two races that do not interbreed readily, nor interdigitation of ranges of the parent races involved. Nor are the birds typical of the normal intergrades developed in areas between two adjacent subspecies. The situation seems more nearly to represent the sort of "hybridizing," or secondary intergradation, to be expected from the interbreeding of fully differentiated parental races (see Miller, 1941, for analagous conditions in the genus *Junco*). The east slope of the Sierra Juárez and the Sierra San Pedro Martír in Baja California, and much of the State of Sonora should probably be included in this area of intergradation, although available material does not serve to make this certain.

Although additional collecting may make it possible to assign parts of the intergrading area to the breeding range of one subspecies or the other, it is clear that this area is both large and real and that any attempt to draw a geographic line across it and to assign specimens breeding on one side to one race and on the other side to the other race would do violence to the biological facts. Equally misleading and fallacious would be the attempt to establish a "size line" for the purpose of placing larger individuals in *sparverius* and the smaller individuals in *penninsularis*.

An interpretation of the distribution of the subspecies that suggests itself is that the ancestors of *penninsularis* were at one time completely isolated in the Cape Region of Baja California, which was then an island, and there became differentiated. Thus Mearns' characterization of *penninsularis* as an "insular race" was probably correct. Upon the rising of the central part of the present peninsula and the development of suitable environmental conditions, the population extended northward to meet the southern edge of the established range of *sparverius*. Coastal Sonora was unoccupied

by sparrow hawks until it was invaded from across the Gulf by *penninsularis*. Farther north, however, and perhaps inland, a scattered population of *sparverius* was already in residence. This population was perhaps newly arrived, or more probably was either physiologically not well suited to local conditions or for some other reason did not offer much competition to the invading *penninsularis*. The latter was thus able to extend well into *sparverius* territory. Since the races were well differentiated, but still able to interbreed freely, the secondary type of intergradation now found was produced.

Measurements of the "breeding" specimens from the area of intergradation are given in table 7. The apparent lesser variability of the females is probably due to chance rather than to an actual difference.

Table 7

Intergrades between *F. s. sparverius* and *F. s. penninsularis*

Measurement	Number of specimens	Observed limits	Arithmetic mean	Standard deviation	Coefficient of variation
Wing length ♂ ♂	19	164-192	182.37 ± 1.86	8.13 ± 1.32	4.46 ± .72
Wing length ♀ ♀	13	176-195	187.62 ± 1.52	5.47 ± 1.07	2.92 ± .57
Tail length ♂ ♂	3	112-114	112.67	....	....
Tail length ♀ ♀	5	110-120	116.60	....	....
Chord of culmen ♂ ♂	14	13.4-15.2	14.09 ± .13	.50 ± .10	3.56 ± .67
Chord of culmen ♀ ♀	13	13.9-15.7	14.62 ± .16	.59 ± .12	4.06 ± .80
Depth of upper mandible ♂ ♂	15	5.6-7.5	6.57 ± .13	.52 ± .10	7.89 ± 1.44
Depth of upper mandible ♀ ♀	12	6.0-7.8	6.79 ± .15	.50 ± .10	7.40 ± 1.51
Tarsus ♂ ♂ and ♀ ♀	19 ♂ ♂ + 13 ♀ ♀	36-43	40.66 ± .26	1.46 ± .18	3.58 ± .45
Middle toe ♂ ♂ and ♀ ♀	8 ♂ ♂ + 8 ♀ ♀	23-26	24.31 ± .22	.88 ± .16	3.61 ± .64

Migrant specimens of *sparverius* are abundant in the area of intergradation, and assignment of subspecific names to specimens collected there in March, April, September, October, November and December (and perhaps in January and February) presents a difficult problem. Since the migrants are probably mostly birds from far to the north, averaging large in size, it should be reasonably safe to class as intergrades any male with a wing length of 178 mm. or less, or any female of 186 mm. or less. A hypothetical collection of equal numbers of resident, intergrade males, and migrant, *sparverius* males, would theoretically have 16.5 per cent of the total distinguishable by wing length (less than 179 mm.) as intergrades. About 30 per cent of the total collection would have a wing length of 190 mm. or greater, of which about four-fifths would be of migrant *sparverius*. Perhaps the safest way to label specimens taken in the area of intergradation in fall, winter and spring would be to label males with wing length of 178 or less and females of 186 or less as "*F. s. sparverius* x *penninsularis*"; males from 179 to 186, and females from 187 to 194 as "*F. s. sparverius* x *penninsularis*?" and males 187 or more and females 194 or more as "*F. s. sparverius*?"

The "hybrid" type of interbreeding and slight degree of overlap of *sparverius* with *penninsularis* might seem reasons for elevating the latter to the rank of a full species. This, I think, would be a mistake. *F. s. penninsularis* is so obviously and so recently derived from *F. sparverius* that nothing would be gained and much would be lost by the separation.

STATISTICAL SIGNIFICANCE

Statistical comparisons of wing length and beak measurements of the races treated are shown in table 8. It will be noted that the comparisons of wing length show a clearly significant difference ($P = < .01$) in both sexes between *sparverius* and *penninsularis*, *guadalupensis* and *penninsularis*, and between both *sparverius* and *penninsularis* and the intergrade population between them. The differences between the beak measure-

Table 8

Statistical comparison of means of measurements of populations of sparrow hawks

	Mean wing length	Mean chord of culmen	Mean depth of upper mandible		Mean wing length	Mean chord of culmen	Mean depth of upper mandible
Male western *sparverius*	187.79 A	13.94 F	6.46 J	Female western *sparverius*	196.43 N	14.47 R	6.58 V
Male eastern *sparverius*	186.32 B	.....	.....	Female *guadalupensis*	196.71 O	14.33 S	6.17 W
Male *guadalupensis*	189.33 C	13.74 G	6.20 K	Female *penninsularis*	175.75 P	14.46 T	6.70 X
Male *penninsularis*	169.22 D	14.43 H	6.70 L	Female *sparverius* x *penninsularis* intergrades	187.62 Q	14.62 U	6.79 Y
Male *sparverius* x *penninsularis* intergrades	182.37 E	14.09 I	6.79 M				

Comparisons

Means being compared	N_1	N_2	Difference	σd	$d/\sigma d$	P.*
Males						
Wing						
Means A and B	54	22	1.47	1.14	1.29	>.1
Means A and C	54	6	1.54	1.94	.79	>.1
Means A and D	54	9	18.57	1.53	12.14	<.01
Means A and E	54	19	5.42	1.47	3.69	<.01
Means C and D	6	9	20.11	2.83	7.11	<.01
Means D and E	9	19	13.15	2.89	4.55	<.01
Culmen						
Means F and G	45	5	.20	.31	.65	>.1
Means F and H	45	7	.49	.27	1.85	.064
Means F and I	45	14	.15	.20	.75	>.1
Means G and H	5	7	.69	.29	2.36	.039
Means H and I	7	14	.34	.25	1.39	>.1
Upper mandible						
Means J and K	45	5	.26	.20	1.31	>.1
Means J and L	45	7	.24	.17	1.44	>.1
Means J and M	45	15	.11	.13	.82	>.1
Means K and L	5	7	.50	.20	2.56	.029
Means L and M	7	15	.13	.21	.63	>.1

Means being compared	N_1	N_2	Difference	σd	$d/\sigma d$	P.
Females						
Wing						
Means N and O	44	7	.28	1.91	.15	>.1
Means N and P	44	8	20.68	1.90	10.88	<.01
Means N and Q	44	13	8.81	1.58	5.59	<.01
Means O and P	7	8	20.96	2.44	8.59	<.01
Means P and Q	8	13	11.87	2.47	4.81	<.01
Culmen						
Means R and S	37	7	.14	.25	.57	>.1
Means R and T	37	7	.01	.28	.04	>.1
Means R and U	37	13	.15	.20	.75	>.1
Means S and T	7	7	.13	.42	.31	>.1
Means T and U	7	13	.16	.36	.44	>.1
Upper mandible						
Means V and W	38	7	.41	.15	2.70	.013
Means V and X	38	6	.12	.16	.73	>.1
Means V and Y	38	12	.21	.14	1.49	>.1
Means W and X	7	6	.53	.15	3.66	<.01
Means X and Y	6	12	.09	.23	.39	>.1

*P. is a measure of significance of use similar to that of $d/\sigma d$, but much more reliable for the comparison of small samples. If P = .05 or larger, the difference of the samples is not shown to be significant; if P = .01 or less, the difference is almost surely significant; in the range from P = .05 to P = .01 the difference may be said to run from possibly to probably significant.

ments are generally not significant, except between the largest-beaked *penninsularis* and the smallest-beaked *guadalupensis*. Since the males and females independently follow the same pattern in beak size: *guadalupensis* < *sparverius* < *penninsularis*, it appears that the biological significance of the size of the beak is greater than the statistical significance.

SUMMARY

This study of variation in sparrow hawks is based on 678 specimens from western North America, of which 171 were collected in May, June, or July, and are presumed to be breeding or to have bred where collected.

Falco sparverius sparverius is the breeding subspecies from Alaska and northern Canada south to about latitude 30° 30′ N. on the Pacific coast of Baja California, but excluding the Colorado and Mojave deserts and the whole watershed of the Gila River. Color characters are unreliable in separating this subspecies from *F. s. penninsularis*. Measurements, especially of the wing, will distinguish all but about 3 per cent of the specimens.

The mean wing length of 54 males of *sparverius* of western North America is 187.79 ± .57; the standard deviation is 4.24 ± .44. Females are not only larger than the males, but are more variable as well.

Birds of the smallest average size come from the southern coastal part of the area studied, and those of the largest average size come from the northern interior.

Falco sparverius penninsularis has been collected in the breeding season from about latitude 30° 05′ N. southward in Baja California, and on Isla Carmen in the Gulf, and at Guaymas, Sonora. On the basis of other evidence it is concluded that this is the breeding race in coastal and southern Sonora, on the Colorado River delta, and in northern Baja California east of the Sierra Juárez and the Sierra San Pedro Martír.

The wing length of nine May, June and July males from Baja California is 169.22 ± 1.47; the standard deviation is 4.41 ± 1.04. It would appear to be safe to assign to *F. s. penninsularis* any male sparrow hawk with a wing length of 178 mm. or less taken in the indicated breeding range at any time of year, and any female similarly taken with a wing length of 186 mm. or less.

The name *F. s. guadalupensis* is proposed for the long-winged, small-beaked, light-collared race inhabiting Guadalupe Island.

In an area comprising the Colorado and Mojave deserts, the whole watershed of the Gila River and its tributaries, and southwestern Arizona south at least to the Mexican boundary, the breeding sparrow hawk population is extremely variable. Individuals typical of both *sparverius* and *penninsularis* occur. There is no evidence of interdigitation or overlapping of ranges. The east slope of the Sierra Juárez and the Sierra San Pedro Martír in Baja California, and probably much of the interior of the State of Sonora should be included in this area of intergradation.

F. s. deserticolus Mearns is clearly a synonym of *F. s. sparverius*. It was apparently based on a series consisting chiefly of migrant birds.

F. s. phaloena (Lesson) is not determinable from the description or locality, and the type is apparently lost. The probabilities seem strong that this name is a synonym of *F. s. sparverius*.

Sparrow hawks may breed when less than one year old.

First year birds disappear rapidly from the population after reaching a peak consisting of about two-thirds of the total population in August. Birds of the previous year make up only some 8 to 12 per cent of the population in the breeding season.

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CONTESTS OF DOUBLE-CRESTED CORMORANTS FOR PERCHING SITES

By GEORGE A. BARTHOLOMEW, JR.

Since the pioneer work of Schjelderup-Ebbe (1922) the investigation of the problem of dominance as a factor in the organization of bird flocks has become a clearly defined and productive field of biological research. Experimental investigations, usually done on small groups of captive birds under controlled conditions, have revealed two main types of dominance-subordinance relationships which have been reviewed by Allee (1938:175-208) and by Shoemaker (1939). In their simplest form the two types of dominance-subordinance relationships are: first, absolute "peck-right," best illustrated by the domestic fowl whose entire flock is organized in a rigid and inflexible hierarchy in which the individual bird pecks with impunity all birds beneath it in the "peck-order" and is pecked by all the birds above it without itself attempting to retaliate; and second, "peck-dominance," illustrated by canaries and domestic pigeons, in which the dominance-hierarchy although present, is not constant or fixed, but varies from time to time depending on many factors such as age, sexual condition of the contestants and the place (territory) in which the contest takes place.

It is obvious that either of these two types of dominance can be fully expressed only when the functional social unit is sufficiently small that frequent and repeated contacts between its members are possible.

It is equally obvious that among birds which habitually form large aggregations, such contacts, because of the large numbers of individuals present, can be neither frequent nor often repeated, except during the breeding season in the nesting area.

During the fall of 1940 incidental to the study (Bartholomew, 1943) of the daily movements of cormorants on San Francisco Bay, opportunity was afforded for the observation of contests among Double-crested Cormorants (*Phalacrocorax auritus*) for perching sites. The following discussion of those contests is presented in the hope that it will cast some additional light on the problem of dominance, particularly as it is expressed in large aggregations of birds. It is entirely possible that in a breeding colony of cormorants the problems of dominance would be quite different from those to be described here, for in such a colony the creation and maintenance of a definite and permanent territory is an important factor.

It is immediately apparent that in a field study where unmarked birds are observed it is impossible for the student to say categorically that two contestants are meeting for the first time. In this paper, however, it is assumed that such is the case. The population of the daytime roost where the observations were made varied from zero to forty and was constantly shifting. The birds were part of a flock which during the period of study numbered in excess of 2000.

Contests to determine the ownership of specific perches on the daytime roosting sites are frequent. Newcomers attempt to chase the occupants away and the occupants in turn try to drive off the newcomers. This competition is especially conspicuous at the more crowded roosts, but contests may occur between a pair of birds when they are the only cormorants on a roost large enough to support fifty or sixty individuals.

The roosts under special observation consist of the pilings west of the Berkeley Yacht Harbor which lies at the foot of University Avenue in Berkeley, California. The pilings are about thirty inches in diameter and approximately eight feet apart. On most of the daytime roosting sites on the Bay the individual perches are not clearly separated so that the cormorants have no sharply defined "roosting territories" which they are stimulated to defend, but these pilings offer a series of definitely delimited

perches, each small enough to be readily defended by a single bird. Such man-made "territories," perhaps through their similarity to the nesting territories which the cormorants maintain in their breeding colonies, call forth vigorous defense behavior. Because of the limited area on the tops of the pilings, the contests here are much more definite than those taking place on a roost where there is plenty of room for the birds to move about. On a spacious roost newcomers can alight on vacant spots and avoid contests; or if a contest does develop, the vanquished bird need not leave the roosting site—it can merely walk two or three feet away and resume its perching. On the pilings the vanquished bird has no alternative but to leave. Another factor which contributes to the frequency of contests on this roost is the small amount of space available on the roost as a whole.

Some of the pilings are broken off close to the water and are submerged at high tide, while others are always three or four feet above the water. Cormorants wishing to roost approach the low pilings by swimming and the high ones by flying.

The competition, although keen, was never seen to result in fights in which the cormorants grappled and attempted to drive each other away by force; it consisted of brief formal contests in which each contestant, by threats, postures, and vocal efforts, tried to force its opponent to depart.

Several types of threats are employed, but all are variations of a single pattern—a vigorous thrust or series of thrusts of the open bill in the direction of the head of the opponent, accompanied by a swelling of the gular pouch and deep hoarse grunting sounds. The contesting birds rarely touch, and when this does occur only the bills establish contact.

A tabular record was kept of sixty-four contests observed during windless early morning hours.

Newcomer driven off by threats of occupant before alighting	19
Newcomer driven off by threats of occupant after alighting	4
Occupant driven off by threats before newcomer alights	15
Occupant driven off by threats after newcomer alights	4
Both occupant and newcomer remain	22
Number of contests in which occupant threatened	45
Number of contests in which newcomer threatened	45

The tabulation indicates the following things: (1) the newcomer and occupant are equally aggressive; (2) the occupants are slightly more successful in maintaining their perches than the newcomers are in usurping them; (3) the number of draws is midway between the number of victories of the occupants and the number of victories of the newcomers; (4) after two birds are established on a single piling, occupant and newcomer are equally successful in driving their opponents away.

All in all these figures support the general impression gained that neither newcomer nor occupant has any significant advantage. The result of a contest is determined not by the status of the contesting birds, that is, whether newcomer or occupant, but by the individual birds themselves and the circumstances in which they find themselves.

Since physical force is not employed, the contests are largely psychological. The bird that can establish dominance by its posture and the vigor of its thrusts and calls is able to drive the other bird away. As a result, it is possible for an observer to predict the probable victor at the very onset of a fight by the strength and aggressiveness of its actions and to predict the probable loser by its nervous defensive attitude. When both contestants are equally aggressive, neither bird is able to drive the other away.

Several factors are of course involved in determining which bird will be victorious. There is undoubtedly an innate tendency for some individuals to be aggressive and

for others to be defensive, or one bird may in previous contacts have established its dominance over the other, but there are other more readily analyzable external factors. The most apparent of these external factors is the direction in which the occupant is facing in relation to the approach of the newcomer. This in turn is dependent on the direction and velocity of the wind. Roosting cormorants always face into the wind and flying cormorants always alight heading into the wind. Thus, when the wind is blowing, the newcomer flies in from the leeward and so approaches the occupant from behind. Because their legs are adapted for swimming rather than walking, a perching cormorant has difficulty in turning around quickly enough to threaten the newcomer adequately. The best it can do is to twist its head and neck around over one shoulder and make a few short thrusts in the direction of the approaching bird. At the same time, however, the approaching bird is not in a position to force the occupant to leave, for both birds are facing the same way and neither can adequately threaten the other. Consequently, when the wind has a velocity of more than twelve or fourteen miles per hour, a high percentage of the contests end in draws. In the course of the afternoon of November 18, 1940, when the wind was blowing approximately fifteen miles per hour, ten contests not included in the foregoing table were observed. Of these, seven resulted in draws whereas normally only about three out of ten contests would end with both birds remaining on the piling.

Another factor of importance is the posture of the roosting bird. Cormorants frequently crouch down flat on their bellies, twist their necks over one shoulder, and tuck their bills in among the feathers of one wing, and they also often stand on one leg with the bill tucked under. Obviously when a bird assumes either of these postures, it is in no position to put up a fight and it rarely succeeds in driving its opponent away.

Cormorants are rather awkward when maneuvering on the wing at close quarters. It is not unusual for one to miscalculate and almost miss the piling. Such an occurrence puts the newcomer on the defensive and immediately places it at such a disadvantage that a single strong thrust of the head by the occupant will usually cause it to give up, drop into the water and swim away.

The contests to be described below are indicative of the various types which occur. All were seen on the pilings west of the Berkeley Yacht Harbor during the months of October and November, 1940.

In slightly less than a third of the contests the newcomer is driven off before it has a chance to alight. The following is typical: A cormorant flew in from the north and started to alight on a piling which was occupied. When the newcomer was about fifteen feet away and beginning to back-paddle with its wings, preparatory to landing, the occupant turned about twenty degrees to the left and faced the approaching bird, leaned forward, partly extended its wings, swelled its gular pouch, opened its bill, drew its head back and then thrust it forward to the full extent of its neck, at the same time uttering a deep coughing grunt. The first threat, completed when the newcomer was about six feet away, had no effect, but when the newcomer was about a yard distant and had its legs extended ready to alight, the occupant again thrust forward its head and open bill and this time the newcomer acted as if it had received a physical blow. It abandoned its effort to alight on the piling so rapidly that it awkwardly fell into the water with a splash. As soon as the newcomer hit the water, the occupant stopped threatening and resumed its preening.

When an occupant is driven from its perch by a new arrival, the behavior differs: A bird flying in from the north circled and headed for a piling on which another cormorant was perched. When the new arrival was at least thirty feet away and just beginning to check its speed, its gular pouch was already fully extended, its mandibles

were parted, its neck was stretched forward, and it was uttering a deep snoring "quork." Even before the newcomer began to call, the cormorant on the piling was visibly excited; it shifted its feet "nervously" from side to side, and made several rapid, short, weak silent thrusts in the direction of its attacker. As it shifted its feet about, it crouched down and backed as far away from the newcomer as it was possible to get and still remain on the piling. The newcomer alighted on the far edge of the piling, made one powerful thrust and the occupant all but fell over backward in its haste to get out of the way and into the water. In this instance, since both birds were immature and both were approximately the same size and there was no apparent external environmental reason why the occupant should have been nervous and defensive, the defeat may have been the result of an established dominance-subordinance relationship.

Frequently the result of a contest is not decided until the newcomer has alighted and both birds are perched together on the piling. The following is a typical example: An immature cormorant was crouched down flat on its belly with the head twisted to the right and lying on its shoulders between the wings. Another cormorant flew in from the north and landed on the piling. The occupant apparently was unaware of the newcomer until the latter had actually alighted on the piling, but as soon as the presence of the intruder was discovered, the occupant, while still crouched on its belly, swung its head around and made two half-hearted thrusts. The note accompanying this threat was not the usual low-pitched grunt, but a high gull-like squawk. The newcomer ignored these threats and as soon as it alighted, began to preen unconcernedly. After remaining motionless for about fifteen seconds following its first threats, the occupant stood up, turned around, moved leisurely toward the newcomer, and twice thrust vigorously and silently at its opponent who retreated, hopped into the water and swam away. It seems probable that the newcomer ignored the first threats of the occupant because the latter was neither in a position to threaten adequately nor to substantiate its threats by force.

As indicated previously, in about one third of the fights, neither contestant is able to drive the other away. For example, an immature cormorant flew in from the north and alighted on a piling on which there was already another immature bird. The occupant who was standing on the edge of the piling farthest away from the approaching bird did not threaten until the newcomer had settled itself on the opposite edge and the two birds were facing each other across the width of the piling. Both opened their bills at the same time, but the occupant took the offensive by leaning forward and darting its head and open bill directly at the head of the newcomer, who instead of hopping off from the piling into the water, merely jerked back its head. As the occupant recovered from the thrust by drawing its head back between its shoulders, the newcomer assumed the offensive and thrust its head forward strongly and then as it in turn drew its head back in order to get set for another thrust, the occupant shot its head forward again. Thus the two birds were thrusting alternately. The thrusts and recoveries were so synchronized that it looked as if the birds' heads were fastened together. Each bird was uttering the usual hoarse "quork," but neither could make the other retreat. After seven or eight thrusts both birds, as if by mutual consent, stopped and paid no further attention to each other. Most indecisive contests end in the same manner. When neither bird is successful in forcing the other to leave, the contest stops abruptly and the two birds pay no further attention to each other. If, however, a third bird should attempt to alight on the same piling, either one or both the occupants may attempt to drive it away. If despite the threats of the two occupants the third bird is able to establish itself on the piling, all three birds perch peacefully together and make no further attempts to drive each other away.

When two cormorants are sharing a piling, the arrival of a third may evoke defensive behavior from either one or both of them, but sometimes when the new arrival is aggressive and the two occupants are so crowded that maneuvering is difficult it can overawe both the roosting birds and drive them off.

The difference in the reactions of two cormorants occupying the same piling when a third bird tries to alight on it emphasizes the importance of the attitude of the individual bird in determining which of a pair of contestants will be victorious. The cormorant which assumes a nervous defensive attitude or an attitude that is aggressive, but not sufficiently aggressive to impress the newcomer, is usually dispossessed, whereas the bird which ignores the newcomer is seldom involved in the contest at all.

Opportunities to observe contests between cormorants on the pilings and those approaching by water are less frequent than opportunities to watch contests involving flying birds, because there are few pilings whose tops are close to the water. Nevertheless, such contests are not infrequent. They follow the same general pattern as those described previously.

The status of the attacking bird when it is swimming differs from that when it is flying, for in the water the newcomer has the disadvantage of having to approach at a relatively slow speed. This allows the occupant ample time to prepare to defend its perch. Although the newcomer loses the opportunity of catching its opponent off guard and overawing it by a swift approach, as well as the chance of attacking from above, it gains in one respect, namely, increased flexibility in method and direction of approach. Double-crested Cormorants are not adept at maneuvering on the wing so if a newcomer approaches a roost in the air and is defeated, it drops into the water and then laboriously takes off, circles and flies in to try again. In contrast, a swimming cormorant can approach from any angle, and it need devote no energy to the complicated business of landing. If it is unsuccessful on its first attempt, it can immediately try again.

The technique of threatening is the same whether the cormorant is flying or swimming. The following is typical of the contests in which a newcomer in the water dispossesses the occupant: A single immature cormorant had been perching for twenty-five minutes on a broken piling whose top was about ten inches above the water when another bird began to swim toward it. When the newcomer was about six feet away, the occupant turned and faced it, partly spread its wings, tipped its body forward and downward, opened its bill, thrust its head and neck directly at its opponent and began to grunt. The swimming bird at the same time also stretched its neck in the direction of the roosting bird, opened its bill and grunted, all the while swimming steadily toward the piling. As the birds came closer together, both became more excited and gave louder and more frequent grunts. The newcomer was not to be daunted; it swam straight up to the occupant. Both began to make short thrusts at each other's heads, but just as its opponent began to climb out on the piling, the occupant lost heart, turned and hopped into the water. As soon as the newcomer had clambered up out of the water, it spread its wings to dry and began to preen.

The following incident is one of the most instructive contests that was seen because it includes successful defense, successful offense, and a rapid change from defensive to aggressive behavior: A cormorant was perched on a piling whose top was less than six inches above the water. Two other cormorants swam up and repeatedly tried to climb up on the piling, but each time the occupant drove them away. On their unsuccessful attempts the attackers had approached from the front, but after three or four unproductive assaults from this direction, one of the birds swam around to the opposite side of the piling, approached the occupant from the rear and managed to climb on

to the piling before the occupant could turn around. Although the newcomer threatened only once, the occupant was unprepared and retreated so rapidly that it fell backward into the water. As soon as it was in the water, the dispossessed cormorant, despite the almost panic-stricken nature of its departure a second before, swam back to the piling and without hesitation chased the other bird into the water.

The importance of the direction of approach is further emphasized by a contest in which four birds were concerned. Three immature cormorants, all facing west, were standing on one of the low pilings when a fourth immature bird swam in from the west and in spite of the efforts of the occupants climbed out on the piling, but no sooner was it on the piling than it was forced back into the water. Instead of giving up, the newcomer swam around behind the occupants and, presumably because the cormorants on the piling were crowded so close together that none of them could turn around to do battle, climbed out onto the piling without a contest. This is the only time four birds were seen perched on the same piling.

Blanchard (1936:145) suggests that, "Consciously or unconsciously, we stress the discontinuity of breeding and winter behavior. We emphasize changes and beginnings and look on song, territorialism and mutual attraction of opposite sexes as exclusive manifestations of the reproductive period—strictly limited phases which begin and end abruptly. Actually, perhaps, effective breeding behavior is less something new than a coordination of many elements already present, some permanently, some as far as we can perceive, for short preceding periods."

These statements apply with particular cogency to the Double-crested Cormorants which I studied, for there are several modes of behavior associated with the contests for the determination of the ownership of particular pilings which can hardly be interpreted as anything other than half-differentiated nuptial displays. It is improbable that these displays are intended as threats, for they never cause the departure of either contestant. The nature of the roosting site on these cement pilings seems to present the proper conditions for calling forth "nuptial displays," for such behavior was never seen at any other roost. This roosting site as previously mentioned is broken into a number of discrete areas, each readily defensible by a single bird and each comparable to the territory existing around a nest in a cormorant rookery.

This similarity under certain conditions apparently evokes fragmentary elements of nuptial behavior which would seem to indicate that in this species the pattern of sexual behavior, although latent during the non-breeding season, can appear even in immature birds in response to temporary environmental conditions independent of the physiological state of the bird. This condition in Double-crested Cormorants agrees with that found in laboratory rats. Lashley (1938:459) states that "There seems to be no item of behavior except parturition and the removal of the fetal membranes from the young which is wholly restricted to the mother rat . . . nests are sometimes built and young retrieved in a manner indistinguishable from that of the best mothers by virgin females and even by males."

The cormorants perform this display only infrequently, but sometimes when a contest has ended in a draw, the occupant displays to the newcomer and vice versa. Occasionally after a newcomer has chased one of a pair of cormorants from a piling, the occupant which remains may perform a "nuptial display," apparently directing its efforts toward the victorious newcomer. Displays are by no means forthcoming every time either of the circumstances mentioned above develop, but they seem to appear only when one or the other of these sets of conditions is met.

The nature of the displays can best be pictured by describing actual instances. The following, a typical performance, was seen at 9:04 a.m. on November 18, 1940.

An immature cormorant flew in from the west and prepared to alight on a piling on which another immature bird was already perched. As the newcomer approached, the occupant reacted in the usual manner, although somewhat half-heartedly. It made three short, weak, silent thrusts which had no visible effect on the new arrival who alighted as if the piling were vacant. As soon as the newcomer was perched, the occupant moved over and stood directly in front of it, so close that the breasts of the birds were touching. Both birds opened their bills, thrust their heads high in the air, gave several high-pitched grunts and intertwined their necks. After rubbing neck against neck for a few seconds, they moved apart and the occupant walked to the side of the piling opposite the newcomer and raised its head high in the air. As it directed its bill vertically, its gular pouch became distended and its whole neck swelled to half again its normal size. The cormorant flexed its legs and crouched down until its breast almost touched the ground but kept its neck stretched upward to its full extent and then hopped eight or ten inches into the air, at the same time uttering a single deep hoarse coughing grunt, much louder, deeper, and more resonant than the "quorks" used in threatening. After this "hop-display" had been repeated twice without evoking the slightest response from the newcomer, both birds began to preen.

On October 20, 1940, at 5:34 a.m., the following incident occurred: An immature cormorant flew in from the north and prepared to land on a piling on which another immature was already roosting. As the approaching bird was about to land, the bird on the piling gave one vigorous thrust with its head and neck and uttered the usual grunt, but the newcomer ignored this threat and alighted directly in front of the occupant. The two birds faced each other, breast to breast. The occupant spread its mandibles, grasped the bill of the newcomer and swung its opponent's head firmly, but gently, from side to side three times. Neither bird made any noise and the newcomer seemed to offer no resistance to having its head waved. The occupant, after releasing the bill of the newcomer, moved to the other side of the piling and, standing sideways to the newcomer, crouched down, stretched its neck upward and hopped into the air giving a hoarse coughing grunt and at the same time bending the upper part of its neck sharply downward from a point three or four inches below the head. The newcomer did not respond in any manner and both birds began to preen.

The following incident involving three birds occurred at 8:03 a.m. on November 28, 1940: An immature cormorant flew toward a piling on which two other birds were already standing. As the newcomer approached, one of the occupants became excited and scrambled about, thrusting its head in the direction of the newcomer, but the other occupant ignored the approaching bird. The newcomer, after alighting and thrusting once in the direction of the excited occupant, who immediately hopped into the water, began to preen without paying any attention to the bird which still remained on the piling. About forty-five seconds after the arrival of the intruder, the second occupant, who up until that time had remained aloof, walked over and made a partial thrust at the newcomer who responded in a similar manner. Then the two birds began to fence with their bills, but they did not appear to be trying to drive each other away. Their movements consisted of short quick forward thrusts of the head followed by swift recoveries interspersed with rapid movements of the head from side to side. The bills of the two birds rarely touched, but once or twice a sharp click was audible to me sixty feet away. The mandibles of one bird repeatedly passed between the open mandibles of the other. After about eight seconds the fencing stopped abruptly and the occupant performed the "hop-display" twice, but the other bird did not respond and both settled down and devoted themselves to preening.

When flying in to alight on a roost, a cormorant ignores the presence of gulls and all birds smaller than itself and lands just as if the site were vacant. It neither calls nor threatens, but as it back-paddles and extends its legs to alight, the gulls or ducks depart without a protest. A single immature Double-crested Cormorant was once observed to cause one Red-breasted Merganser (*Mergus serrator*), two Lesser Scaups (*Nyroca affinis*), one Ruddy Duck (*Erismatura jamaicensis*), and one Canvas-back Duck (*Nyroca valisineria*) to hop precipitantly into the water and swim rapidly away. Apparently there is no need for cormorants to threaten; their size, the speed of their approach, and the vigor of their back-paddling is enough to chase smaller birds away.

I have never seen a gull of any species, either mature or immature, offer resistance of any sort to the usurping of its perch by a cormorant, whether the latter approached by flying, swimming, or walking. Although gulls frequently chase each other off roosts, they never attempt to rob a cormorant of its perch. Possible reasons for this situation are, first, that cormorants are somewhat larger than gulls, and second, that gulls are buoyant fliers whereas cormorants are not and it requires less effort for a gull to fly away than for a cormorant to change its direction once it has begun to back-paddle preparatory to landing.

Only once have I seen a bird of another species chase a cormorant from a roosting site. During the winter of 1941, there was a single escaped Mute Swan in the Berkeley Aquatic Park. On one occasion, it swam rapidly in the direction of an immature Double-crested Cormorant which seemed frightened by the approach of the larger bird and hopped into the water and swam away when the swan was about four feet distant. The swan neither threatened nor attempted to chase the cormorant.

A cormorant was seen making an unprovoked threat at a bird of another species only once and this incident can probably be explained by the fact that both birds involved were on a log hardly more than eight inches across so that they had no way of keeping out of each other's way. A Killdeer (*Oxyechus vociferus*) had been perching quietly among seven cormorants on the log boom in the Berkeley Aquatic Park for six or eight minutes when for no apparent reason the nearest cormorant turned and walked in its direction. When the cormorant was about two feet away, it stopped, opened its bill, and thrust its head at the Killdeer which immediately flew away calling loudly. The cormorant then walked slowly along the log and perched about eighteen inches beyond the spot where the shore bird had been.

Double-crested Cormorants tend to remain aloof from the other species of birds associated with them on the daytime roosting sites. They almost always elect to alight on that part of the roost where there are other cormorants and to avoid that part of the roost where there are ducks or gulls, although when the amount of space available is small they do not hesitate to alight among birds of another species.

The only native species of bird on the Bay which was seen going out of its way to annoy cormorants was the Western Gull. On three different occasions these gulls were seen deliberately and for no apparent reason bothering the cormorants. In the first instance, an immature cormorant was standing facing northwest on a log in the Berkeley Aquatic Park, when an immature Western Gull flew in from the south and landed about two and a half feet in back of the cormorant. After eighteen or twenty seconds the gull cocked its head to one side, twisted its neck to the right, sidled up behind the cormorant, deliberately stretched its neck out, grasped the cormorant's outer tail feathers with its bill and gave a sharp tug. The cormorant, which up until it felt the tug had seemed unaware of the gull's presence, instantly whirled about, opened its bill and threatened its assailant by thrusting its head out to the full length

of its neck. The gull immediately backed up rapidly for about fifteen inches and the cormorant, after the single silent thrust, resumed its original position with its back turned to the gull. Twenty seconds after the first tug, the gull again sidled up behind the cormorant and again pulled one of its outer rectrices. Once again the cormorant turned around and threatened the gull who once more backed up about a foot. After an interval of thirty seconds the gull repeated the tug and once again evoked the same threat from the cormorant who this time did not shift its feet and turn around, but merely twisted its head to one side and thrust its open bill over one shoulder at its annoyer. The cormorant made no further attempt to drive the gull away, and after about forty seconds the gull departed of its own accord.

On the second occasion a gull chased a flying cormorant. Nine cormorants and three gulls were perching on the pilings west of the Berkeley Yacht Harbor. About two seconds after one of the cormorants had taken off and flown west, one of the gulls also left the pilings and soon caught up with it. The cormorant at first paid no attention to the gull which then was flying about five feet behind and two feet above it, but after traveling about two hundred yards, it turned sharply to the left and began to gain altitude to cross the Berkeley Pier. The gull followed along close behind and the cormorant became excited and swerved first to the right and then to the left. The gull followed these maneuvers effortlessly and the cormorant made no further attempt to dodge, but continued to fly steadily with the gull following until lost to sight.

The third instance is similar to the second. A gull resting on the water took off and chased a cormorant which passed overhead. After the gull had followed the cormorant for about eighty feet, flying approximately two feet behind and one foot above it, the cormorant swerved sharply three times but was unable to lose its pursuer. It then banked steeply and dropped almost vertically into the water, whereupon it turned and faced the gull, who after hovering about five feet overhead for eight or nine seconds flew away southward. As soon as the gull departed, the cormorant took off and continued its way northward. The cormorant apparently dropped into the water for the express purpose of escaping its annoyer.

It seems that in both of these chases, the gulls pursued the cormorants for no reason other than play, because robbery could not have been the motive.

The relationship between Western Gulls and Double-crested Cormorants depends on the circumstances under which the two species come in contact. On roosts where there is plenty of room, the two remain aloof and pay no attention to each other. When there is a shortage of perches, the cormorants chase the gulls away. When they are fishing, the cormorants ignore the gulls, and the gulls attempt to rob the cormorants only when the latter have caught a fish almost too large for them to handle. In the air, the gull is dominant and easily chases the cormorant who can do nothing but dodge ineffectually. On the ground or in the water the gull moves aside at the approach of a cormorant. Cormorants do not go out of their way to annoy gulls, but the opposite sometimes takes place.

SUMMARY

The analysis of contests by Double-crested Cormorants over roosts on a group of pilings lying west of the Berkeley Yacht Harbor, Berkeley, California, indicates that at least in large flocks of non-breeding birds of this species no absolute "peck-right" exists but instead a condition approximating the more flexible "peck-dominance." The winner of a specific contest is usually determined on the spot and seems to depend primarily on such external factors as wind direction and velocity, posture of the roost-

ing bird, direction and approach of the attacking bird and the crowding of the birds already present on the roost.

So dependent is the outcome of a contest on external conditions that on occasion the occupant of a roosting site may, because of a poor strategic position, be dispossessed and then with the condition reversed, immediately shift from defense to offense and regain its perch from the bird which had just vanquished it.

The contests are purely psychological and consist entirely of threats, postures, and calls which occasionally merge into incomplete nuptial displays despite the fact that immature birds are involved and that the action takes place in the non-breeding period (November).

With the exception of the Western Gull, the cormorants in the area of observation had no friction with the other species with which they associated. On three occasions gulls of this species were seen deliberately annoying Double-crested Cormorants but the converse was never true. In the air the cormorants assumed the defensive, but on the ground or water, the gulls yielded to the cormorants without resistance.

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Museum of Vertebrate Zoology, Berkeley, California, July 15, 1943.

FROM FIELD AND STUDY

Sex Ratios in Wintering Gambel White-crowned Sparrows.—Incidental to certain studies of castration of migratory birds at Davis, California, it was noticed that males outnumbered females in the local wintering population of the Gambel White-crowned Sparrow (*Zonotrichia leucophrys gambelii*) by more than five to one. In a series of 101 of these birds trapped in 1940 and 1941 there were 87 males and only 14 females. Dr. Barbara Blanchard, trapping in the same locality during the winter of 1942-43, recorded 224 males and 38 females (forty smallish birds liberated without being sexed might have slightly modified the ratio indicated by this collection; her figures, therefore, have not been included in the tabulation shown on the map). Museum specimens, presumably taken by shooting, showed the same picture of male predominance in the Davis region with 13 males and only 2 females.

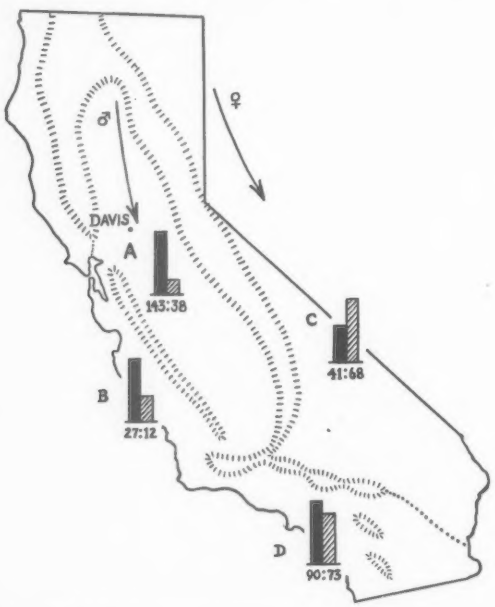

Fig. 51. Sex ratios in wintering populations of Gambel Sparrows as indicated by specimens in the Museum of Vertebrate Zoology and by trapping records at Davis. A, Sacramento-San Joaquin Valley; B, central coast area of California; Great Basin, including Nevada, Utah, New Mexico, parts of Arizona and the Mojave Desert of California; D, southern California and adjacent areas in southern Arizona and Lower California. Black columns indicate males, shaded columns, females.

Data in the catalogue of specimens in the Museum of Vertebrate Zoology at Berkeley indicate that there is a partial segregation of the sexes of wintering Gambel Sparrows on opposite sides of the Sierra Nevada. Specimens collected to the west of these mountains showed a ratio of more than three males to every female, while on the east side females outnumbered males almost two to one (fig. 51). The sex ratio south of the Tehachapi Mountains was roughly one to one.—JOHN T. EMLEN, JR., *University of California, Davis, California, June 28, 1943.*

Starlings Nesting in Montana.—On May 15, 1943, Starlings (*Sturnus vulgaris*) were discovered bringing food to nestlings in a cavity in a barn at the North Montana Branch Station, seven miles southwest of Havre, Montana. On the day following, a pair was seen carrying material to an opening high up on the side of a grain elevator at Laredo, a few miles southwest of the Station, and it was presumed that they were nesting at this point also. As far as I am aware this is the first record of nesting of this species in Montana.

In the course of the past five years I have had opportunity to collect a number of records of this species in Montana. The first one for the state, of which I have knowledge, is based on a bird found dead at Lindsay in January, 1939. In February of the same year I examined a caged Starling which had been captured on a ranch near Great Falls. This occurrence is discussed by Wessel (Montana Farmer, 26, 1939:10). Other records, exclusive of those given by Wright (Condor, 45, 1943:119) are as follows:

Big Timber	Stillwater County	October, 1939
White Sulphur Springs	Meagher County	December, 1939
Sieben	Lewis and Clark County	March, 1940
Silesia	Carbon County	July, 1943
Savage	Richland County	July, 1943
Chinook	Blaine County	July, 1943

As yet, I have seen no evidence of flocking of this bird in the State, all of my records being for one or two birds. Wright (*op. cit.*) mentions but five or six in the group observed by him. It would seem that as of this date the Starling is uncommon but widespread in Montana.—HARLOW B. MILLS, *Department of Zoology and Entomology, Montana State College, Bozeman, Montana, July 12, 1943.*

Starling in Northern Idaho.—In the course of my recent study of the birds of northern Idaho, Bill Musgrove reported to me that he had observed a Starling (*Sturnus vulgaris*) on a telephone wire one mile east of Moscow, Latah County, Idaho, on December 13, 1941. He has collected this species in Montana and was certain of his identification, which to the best of my knowledge is the first record of the Starling in northern Idaho, if not in the whole state. This individual was apparently a winter straggler as were those seen in western Montana by Wright (Condor, 45, 1943:119).—ANDREW C. OLSON, JR., *San Diego, California, June 14, 1943.*

Notes on the Shore Birds of Washington.—The following is a miscellany of unpublished data on shore birds of the State of Washington which for various reasons are considered worthy of record. Unless otherwise stated, they are the results of my field activities in the past four years.

Charadrius semipalmatus. Semipalmated Plover. A solitary female was taken by the writer on the Tacoma tideflats on July 22, 1940. On August 25 of the same year I saw one, with a killdeer, on the Nisqually flats, and on August 29 a group of about 12 were seen at the same place. The species has been rarely recorded on Puget Sound, although it is common on the ocean beaches at Westport.

Squatarola squatarola. Black-bellied Plover. Miller, Lumley, and Hall in their "Birds of the San Juan Islands, Washington" (Murrelet, 16, 1935:51-65) were able to include this species in their list only hypothetically. It was common at Smith Island, southernmost of the islands of San Juan County, during a visit there from March 25 to 27, 1942; a specimen was taken on the 26th.

Arenaria melanocephala. Black Turnstone. Miller, *et al.* (*ibid.*: 58) list only a single spring record of this species for the San Juans. On April 23, 1939, I saw at least a score on Decatur Island, and at Smith Island from March 25 to 27, 1942, I saw large numbers, collecting one on the 26th. They are quite rare on southern Puget Sound; on August 12, 1940, I saw a single bird near Dash Point, north of Tacoma, and on the 28th following, took two from a barnacle-covered snag at the mouth of the Nisqually River.

Actitis macularia. Spotted Sandpiper. Gabrielson (Condor, 25, 1923:106) has published a winter sight record of this species for the Olympic Peninsula and mentions that it has occasionally been taken along the Washington and Oregon coasts in winter. While fishing for steelhead in the Nisqually River a few miles above its mouth on February 4, 1940, I observed a single Spotty repeatedly and at close range, as it worked along the river's edge. The majority of this species seems to arrive in May and leave in August in the vicinity of Tacoma.

The ability of this species to dive into, swim under, and take wing from either still or running water has been frequently mentioned in the literature (see Bent, U. S. Nat. Mus. Bull. 146, 1929:87-89; Sutton and Pettingill, Auk, 59, 1942:10). The plight of a bird found on a warm spring day (May 19, 1940) in a rearing pond at the state fish hatchery near Steilacoom may be of interest as an indication of the limitations of these abilities.

As we approached the long, vertical-sided concrete pond, a Spotted Sandpiper flew up and away to a near-by lake. To our surprise we found a second bird, an adult with spotted breast, struggling to rise from the water, heaving its shoulders up with frantic wing-beats or lying exhausted with back awash and wings outstretched just below the surface. I fished it out and placed it on the back seat of the car where it crouched, shuddering, and nearly toppling on occasion. As its matted plumage dried it became progressively more active, scampering about the back of the car, teetering for all it was worth, and occasionally voiding. The bird was silent except once when it gave a shrill *weet* and other more obscure notes while I was attempting to catch it. By 4:30 p.m. (3 hours and 45 minutes after capture) it seemed wholly recovered. Placed on the lawn of a residence a few miles removed from the scene of capture, it flew off and was lost to sight. Mr. Foster, the hatchery superintendent, said the bird was not in the pool at 12:15, half an hour before we found it there. How this bird could have gotten into such a predicament is hard to understand. The pool was filled with trout, but these did not seem to be attracted to the bird. The water was clear; perhaps the depth was deceiving. The appearance and behavior of the bird while captive led us to consider it in normal good health.

Tringa solitaria. Solitary Sandpiper. Solitary Sandpipers are rare indeed in western Washington, if not in the entire state. On May 2, 1939, a single bird was observed at a distance of only a few yards as it fed and made short flights about a temporary pond at the north end of Snake Lake in Tacoma. Light and other conditions were ideal, binoculars were used, and the identification was made carefully on the basis of appearance, behavior, flight, and notes, all of which were recorded on the spot.

Totanus flavipes. Lesser Yellow-legs. Considered rare in western Washington generally. My experience at Tacoma indicates that they are regularly present from July to September, occasionally outnumbering the common Greater Yellow-legs in the latter two months (as on September 11, 1940, and August 11, 1942). Two females in my collection were taken September 11, 1940, and September 7, 1941, the latter being taken away from a Pigeon Hawk (*Falco columbarius*). I have carefully identified this species on the Tacoma flats as early as July 6, 1940.

Calidris canutus rufus. Knot. I have seen this species on but two occasions. Two, in the company of other shore birds at the mouth of the Nisqually River, were observed closely and positively identified on August 28, 1940. Opportunities for collection were missed. The birds showed considerable curiosity, flying together out to, and around, our rowboat on two occasions. The note as they flew by or stood on the ground was an occasional rather low and harsh *tchurk*. Again on August 23, 1942, a single bird was identified on the Tacoma flats. Bowles (Auk, 23, 1906:141) records a specimen taken at Tacoma in September, 1897, and Rhoads (Proc. Acad. Nat. Sci. Phila., 1893:36) implies their presence (not collected) at Nisqually in April, 1892.

Arquatella ptilocnemis couesi. Aleutian Sandpiper. Two males taken on March 26, 1942, from flocks of Black Turnstones on the shores of Smith Island, San Juan County, by Dr. V. B. Scheffer and the writer are in my collection (nos. 1076 and 1077). Measurements of number 1077 are nearly average for *A. p. ptilocnemis* as given by Ridgway (U. S. Nat. Mus. Bull. 50, Part 8, 1919:245), and this specimen is likewise noticeably lighter colored than the other. Both are *couesi*, however, according to Dr. Herbert Friedmann, who kindly examined the skins. This is an addition to the list of the birds of the San Juans (Miller, *et al., op. cit.*).

Pisobia acuminata. Sharp-tailed Sandpiper. I have seen this species in the field only once. On August 11, 1940, a single bird was observed on the edge of a salt marsh at Tacoma. Two specimens in the D. E. Brown collection at the Washington State Museum are from Washington and bear the following data: W.S.M. 7800, female, October 29, 1927, Westport, Grays Harbor Co.; W.S.M. 7801, female, November 2, 1927, Nesqually (*sic*), Pierce Co., collected by Stanton Warburton, prepared by D. E. Brown.

Pisobia melanotos. Pectoral Sandpiper. In my experience, irregular at Tacoma during September and October. On September 13, 1939, I saw one of this species at Sprague Lake, Lincoln County, in eastern Washington.

Pisobia bairdii. Baird Sandpiper. On July 30, 1940, I collected two of three individuals seen on the ocean beach north of Grayland. A group of skins in the D. E. Brown collection at the Washington State Museum are of interest because they come from Neppel, Grant County, in the eastern part of the state, and because two are spring records. Data are: September 14, 1935 (1 male?), September 15, 1935 (female), September 24, 1934 (female), April 8, 1936 (2 males). A specimen in the E. A. Kitchin collection at the College of Puget Sound comes from southern Puget Sound (Tacoma tideflats, Pierce County, male, August 3, 1918).

Limnodromus griseus hendersoni. Interior Dowitcher. Three fall birds in my collection from Nisqually (August 28, 1940, and September 23, 1941) have bills measuring 56 (male), 57 (unsexed), and 62 (female) millimeters, and seem otherwise to agree with Rowan's (Auk, 49, 1932:14-35) and

Conover's (Auk, 58, 1941:376-380) diagnoses of *hendersoni*. Jewett (Condor, 44, 1942:79) has recently recorded this race for the first time in Washington on the basis of a single spring bird collected at Westport, on the coast.

Tryngites subrufficollis. Buff-breasted Sandpiper. This rare species was met with on two occasions at Nisqually during late August, 1940. On the 25th a single bird was seen near the mouth of the river, and on the 28th one was collected in the same area (♂, 1080 JWS). There is, moreover, a male in the E. A. Kitchin collection taken on the Tacoma tideflats on September 7, 1919.

Crocethia alba. Sanderling. The Sanderling is rare on southern Puget Sound. On September 19, 1940, I collected a solitary female on the beach northeast of Dash Point near Tacoma, and on September 21, 1941, I saw a flock of 7 at the same place. In the San Juans it was "seen in considerable numbers on Smith Island by Rathbun, March 26, 1910" (Miller, *et al., op. cit.*:58). Dr. Scheffer and I found them common at the same place precisely 32 years later (March 25 to 27, 1942; one collected on the 26th).

An albino skin of this species in my collection may be of interest. It is a female, collected on March 5, 1939, on the beach at Ocean City, Grays Harbor County. The soft parts were noted at death as follows: iris and bill dark brown, feet pale grayish brown. A normal specimen collected at the same time had the feet and bill black, iris dark brown. The plumage is generally white except for notable amounts of dull brown on the primary coverts, the pigment continuing proximally in a more dilute tint as far as the wrist and distally for about half the length of the outermost primaries.—JOHN W. SLIPP, *Tacoma, Washington, August 21, 1942.*

Uncommon Birds at the San Gabriel River Bird Sanctuary, California.—A Harris Sparrow (*Zonotrichia querula*) was seen by many people at various times between March 27 and April 25, 1943, at the San Gabriel River Bird Sanctuary, 12 miles east of Los Angeles, California. It was among a concentration of White-crowned (*Z. leucophrys*) and Golden-crowned (*Z. coronata*) sparrows. Once the writer heard its soft musical notes. It was generally found on or near a local garden adjacent to the sanctuary where birds were fed daily.

A Green-tailed Towhee (*Oberholseria chlorura*) also spent most of the winter around the feeding table of the sanctuary.

A Summer Tanager (*Piranga rubra*) was seen and heard in the sanctuary by the writer on February 12. It showed reddish on the rump and shoulders. Although the spot was visited for several days, the bird was not seen again.

A Western Flycatcher (*Empidonax difficilis*), not uncommon in summer, was seen and heard by the writer and Mrs. Comby on February 12 and 15, and before and after those dates.

A White-throated Sparrow (*Z. albicollis*) was seen and heard both this spring and last spring. Black-and-White Warblers (*Mnioitilta varia*) seem to be regular visitors in the fall. They have been observed for the last six years by the writer and others.—J. H. COMBY, *Pico, California, June 19, 1943.*

Flight-Feeding of the Ring-billed Gull.—Although no known nesting colony of the Ring-billed Gull (*Larus delawarensis*) is located in the Lahontan Valley, Churchill County, Nevada, the species occurs within this valley at all times of the year. On three occasions, in this area, Ring-billed Gulls have been seen feeding in flight. This behavior, similar on all three occasions, may be described as follows.

Flight was slow and irregular and often birds within a flock were flying in opposite directions. Repeatedly it was noted that an individual would cease flapping its wings and sail upward. Then it appeared to hesitate momentarily, as it probably captured an insect and then dropped downward for a short distance as normal flight was resumed.

A flock of about 50 gulls was seen feeding in this manner 2 miles east of Lahontan Dam on September 12, 1942. They were flying and feeding from 100 to 500 feet from the surface of the ground. The distance between the two outside individuals of the flock did not exceed 600 feet.

Another flock of about 30 gulls was seen feeding in flight 3½ miles west-southwest of Fallon on October 5, 1942. Mr. Vernon L. Mills obtained two of the gulls from this flock. Examination of their stomachs, gullets, and mouths revealed many insects. Those in the mouths were saved and later identified by Herbert T. Dalmat of Cornell University as ants of the species *Lasius* (*Acanthomyops*) *murphyi* and *Lasius* (*A.*) *latipes*, and the host of these two, *Lasius* (*Lasius*) *niger americana;* there also were two stink bugs (Pentatomidae).

The third flock, consisting of about 100 gulls, was seen 4 miles west of Fallon on October 17, 1942. These were feeding about 60 to 300 feet above the ground. Examination of one gull that was

shot revealed ants (queens of *Lasius* sp.) in its mouth.—J. R. ALCORN, *United States Fish and Wildlife Service, Fallon, Nevada, June 27, 1943.*

The Bobolink in New Mexico.—Florence Bailey, in her "Birds of New Mexico" (1928:637) stated that since the Bobolink (*Dolichonyx oryzivorus*) is a fairly common migrant in Colorado, it might be expected in New Mexico and that observers should be on the lookout for it.

So far as I know, the Bobolink has gone unrecorded in New Mexico until noon on May 15, 1943, when an adult male in breeding plumage was observed at a small tule pond, 45 miles north and slightly west of Albuquerque, in Sandoval County. The pond is situated on the Ojo del Espiritu Santo Grant, 18 miles northwest of San Ysidro. I first saw the bird when it flew from the ground and alighted thirty feet away on the dry seed stock of a cattail. The day was bright and my view was unobstructed. I have known the Bobolink in the East, and there is no question as to identity.

The bird was still at the pond at 5:00 p.m. on May 15, but it was not observed when I again visited the pond on June 14.—A. E. BORELL, *Soil Conservation Service, Albuquerque, New Mexico, June 19, 1943.*

Additions to the Avian Check-list of Lassen Volcanic National Park.—While residing in Lassen Volcanic National Park in northeastern California in the summers of 1941 and 1942, the writer observed the following birds which, according to the park check-list, have not been previously reported within the park boundaries.

Dafila acuta. Pintail. Observed on June 27, 1942, on Manzanita Lake, elevation 5845 feet.

Spatula clypeata. Shoveller. Observed on July 10, 1941, at Manzanita Lake. Two individuals, apparently adult females, were seen swimming among the snags and partly submerged logs in a small cove on the south side of the lake. The supposed sex of these individuals in conjunction with the date of their appearance suggested that they might be breeding birds but no nests or young could be found.

Erismatura jamaicensis. Ruddy Duck. Observed on June 27, 1942, at Manzanita Lake. An adult female in full nuptial plumage was seen diving intermittently several hundred feet from shore in water known to be of a depth of from 10 to 15 feet.

Cryptoglaux acadica. Saw-whet Owl. On August 1, 1941, at about 10:30 a.m. (Pacific Standard Time) in the vicinity of Manzanita Lake, an adult bird was discovered perched close to the trunk of a lodgepole pine at a height of approximately 12 meters. Its presence was heralded by the alarm notes of juncos, chickadees, nuthatches and other small birds.

The owl seemed but mildly concerned about the sounds and movements made by a group of at least a dozen people who had been attracted to the tree by the chorus of excited birds. It only occasionally interrupted its nap to survey the ground below through half-closed eyelids. Even the constant chatter and the occasional sallies of the more adventuresome among the horde of small birds did not cause it to change its position.

At 3:30 p.m. on the same day, the tree was again visited. The bird had apparently moved but little, for it was still perched on the same limb. This time there was a notable absence of other birds. They had probably become accustomed to the owl's presence. Once again the bird showed its disinclination for movement. In an effort to get it into a more suitable place for photographing, it was first pelted with rocks, pine cones, and sticks and then, failing this, the writer climbed an adjoining tree to within a few feet of its position. In spite of shaking branches, shouting, and a hail of pieces of bark, twigs and other missiles, it would not give up its coveted retreat. On the next day a third visit was made to the "owl" tree on the chance that the bird might be regularly roosting in the region, but it was not found.

The following summer, on July 7, the alarm notes of robins coming from a Jeffrey pine adjacent to the Loomis Museum at Manzanita Lake drew attention to a juvenal Saw-whet Owl. The little fellow was being subjected to a merciless attack by two beak-clacking robins which had a nest near by. It was finally driven to a lower level in the tree, making it possible for me to get within 8 to 10 feet of the bird by climbing on to the roof of the museum. From this vantage point I could see that the owl clutched the remains of a white-footed mouse in its claws. In a few moments the rodent was swallowed and the bird took wing, roughly ushered out of the area by the perturbed robins.

Psaltriparus minimus. Bush-tit. Observed by ranger-naturalist George Hale on August 9, 1941, near Manzanita Lake.

Dendroica townsendi. Townsend Warbler. An adult male was observed on August 7, 1941, on the Bumpas Hot Spring Trail, elevation approximately 8200 feet. It was among the branches of a mountain hemlock and came within a few feet of the observer in response to an imitation of a bird in distress.

Dendroica nigrescens. Black-throated Gray Warbler. Two birds were attracted by "squeaking" on August 29, 1942, on the Lily Pond trail near Reflection Lake, at about 6000 feet. They appeared in a lodgepole pine. One was clearly an adult male, the other either a female or a juvenal bird.

Manzanita Lake is situated in an area which exhibits a remarkable intermingling of plant types of the Canadian and Transition zones. For example, along the Lily Pond trail near Reflection Lake, it is possible for one to see ten different kinds of cone-bearing trees within the short space of a quarter of a mile. This diverse array of conifers is composed of the following species: incense cedar, yellow pine, Jeffrey pine, sugar pine, lodgepole pine, white pine, white fir, red fir, false hemlock, and mountain hemlock—a surprising mixture of plant "indicators" of the two life zones mentioned. In addition there are large areas in the vicinity of the lake that have been burned over and now exhibit a thick growth consisting principally of manzanita and ceanothus.

Along with these peculiarities in the vegetative cover of the Manzanita Lake region, it is not surprising to encounter a wide variety of birds. Thus one finds such birds as the Bush-tit, Black-throated Gray Warbler, and Clark Nutcracker mingling in the same general area.—ROBERT C. STEBBINS, *Department of Zoology, University of California at Los Angeles, July 15, 1943.*

White-throated Swift Nesting in Active Quarry.—In June, 1941, I located a small colony of White-throated Swifts (*Aëronautes saxatilis*) breeding on the face of an abandoned rock quarry at Rockaway Beach, 15 miles south of San Francisco, San Mateo County. The fateful day of December 7, 1941, also had an effect on the swifts, as the quarry was re-opened. Upon returning there this year on June 27, I was surprised to find approximately eight pairs of swifts still there. I located six nesting sites of swifts along with those of a Barn Owl (*Tyto alba*) and two Rock Wrens (*Salpinctes obsoletus*). The birds have withstood the constant blasting and roar of caterpillar bulldozers and compressors. The noise of war has also entered the bird world and the birds appear to be taking it in stride!—C. ANDRESEN, *San Rafael, California, July 2, 1943.*

Some Unusual Nesting Habits.—A unique nesting place for Pigeon Guillemots (*Cepphus columba*) is provided by the timbers beneath the flooring of San Simeon wharf, San Luis Obispo County, California. "Kelly" Truesdail of Paso Robles in 1933 said that nesting had occurred there for a number of years. Since then I have observed eggs, chicks and brooding adults several times through spaces in the flooring planks. Small orange-colored eels are the only food I have seen given to the chicks. On August 16, 1940, similar food was given to young at Point Buchon, thirty miles to the south.

About 1930, in the summer months, I found the nest of a Water Ouzel (*Cinclus mexicanus*) in a yew tree by the Sacramento River, south of Castella, Shasta County. The tree, which was less than ten feet high, grew on the river's edge with some limbs extending out over the water. The nest was about four feet above the water; the dried moss of the nest was easily seen, but when fresh the nest was no doubt well camouflaged by the dense outer foliage in which it was built.

On June 25, 1939, I found the nest of a Sora (*Porzana carolina*) at the edge of Mono Lake, Mono County. It contained twenty-two eggs; seventeen eggs were in the nest-cup, and two were built into the side and three into the bottom of the structure. The bottom of the nest rested in the water, suggesting that after construction the water level had risen or the supporting sedge stems had sagged. This perhaps stimulated the building of the added layer after three eggs had been laid; in the course of rebuilding, two more were laid and built into the side of the nest.—DALE T. WOOD, *Lompoc, California, March 29, 1943.*

Mallophaga on Young White Pelicans.—Mallophaga or biting bird lice are known to eat feathers, hair, dry skin, and dried blood, and occasionally to cause some irritation by rasping the skin surface. As far as I know, however, they have not been recorded as congregating to form large open sores. Observations which I had opportunity to make on young White Pelicans (*Pelecanus erythrorhynchos*) on Anaho Island, Pyramid Lake, Nevada, June 14, 1942, therefore seem of decided interest. The naked young pelicans up to about two weeks of age were found to be heavily infested with the large bird louse *Tetrophthalmus* sp. The lice were kindly identified by Professor G. F. Ferris of Stanford University. The species, or possibly two species, cannot be named for certain until further work has been done on the group. Probably synonymous with one or both of these species is *Menopon perale*, described by Leidy (Proc. Acad. Nat. Sci. Phila., 1878:100-101) and mentioned by Hall (Condor, 27, 1925:152).

Fig. 52. Young White Pelican, about 1½ weeks old, infested with bird lice; Anaho Island, Pyramid Lake, Nevada, June 14, 1942.

The bird louse of the young pelicans is the same as that commonly found on the inner surfaces of the pouches of adults. In the very young birds, however, the bird lice were almost entirely confined to certain external regions, namely the skin fold at the lower back of the neck and the axillae. They were clumped there in almost solid masses around deep open sores (fig. 52).

It seemed clear that the mallophaga were actually making these wounds. All degrees of concentration and of injury were found, from a few insects in a barely started sore to dozens in a large sore. No bleeding was observed, apparently because the bird lice were eating all blood that exuded. The effect of the parasites on the pelicans could not be ascertained. Many small young pelicans, most often the younger of two in a nest, die but perhaps primarily because of their inability to protect themselves from the pecking of the older young or their inability to obtain adequate food. It seems likely, nevertheless, that large numbers of mallophaga could significantly weaken and irritate the young.

The majority of the small young, in fact 77 per cent of 50 birds chosen at random, were heavily infested with bird lice. In contrast, the young of several weeks' age or older did not have any external concentrations of the parasites. Several factors may explain this, the most important one perhaps being that down and contour feathers later afford food and protection so that the mallophaga can scatter over the body. Also, the pouches of the young become increasingly large, providing the normal adult environment for the bird lice.—FRANK RICHARDSON, *University of Nevada, Reno, Nevada, June 15, 1943.*

NOTES AND NEWS

A valuable bibliographic service is offered to students of birds by the editorial staff of the Wilson Bulletin, official organ of the Wilson Ornithological Club. Each quarterly issue lists titles from recent literature on North American ornithology and general avian biology. In the June issue, 104 titles are classified under major headings such as physiology, anatomy, ecology, life history and behavior. These lists are offered as separates, printed on one side of a page only, so that they may be cut and adapted to a particular bibliographic system. The annual cost is $ .25 for one set, $ .40 for two sets. Requests and remittances should be sent to Dr. Josselyn Van Tyne, Museum of Zoology, University of Michigan, Ann Arbor, Michigan. This service is available to anyone interested.—F. A. P.

PUBLICATIONS REVIEWED

In the American ecological literature, two different biogeographic classifications have been prominent; the life-zones of Merriam and the biomes of Shelford. To these two systems may be added Dice's biotic provinces, in use for some years by Dice and his students in local studies, but only recently applied to the entire North American continent north of central Mexico (Dice, Lee R. 1943. The Biotic Provinces of North America. Ann Arbor, University of Michigan Press, viii + 78 pp., 1 folded map; price $1.75). Dice's studies constitute another attempt to recognize, delimit, and classify the major ecological divisions of this continent and to provide some rational basis for the analysis of biotic interrelations bearing upon distribution.

There are four basic units in Dice's system. A *biotic province* is a biogeographic unit which "covers a considerable and continuous geographic area and is characterized by the occurrence of one or more important ecologic associations that differ, at least in proportional area covered, from the associations of adjacent provinces" (p. 3). *Biotic districts* are subdivisions of the provinces, based on "ecologic differences of less importance than those that separte biotic provinces." (No other criterion is given.) A *life belt* is a "vertical subdivision of a biotic province" (p. 3), but also apparently of a biotic district (p. 4), although this is not stated to be so. Lastly, Dice recognizes the *ecologic association* as a "uniform and relatively stable community below the rank of life belt and biotic district" (p. 4). Each of several "well-marked successional stages as well as . . . the climatic or edaphic climax of an area" are recognized as separate ecologic associations.

In all, 29 biotic provinces are described. Each description, one-half to three pages in length, is an orderly, brief account of geographic limits, origin of name, synonyms (drawn chiefly from community units of bioecologists), relations to neighboring provinces, topography, climate, soils, vegetation, together with mention of biotic districts if any have been recognized and comment on certain characteristic animals, chiefly mammals. In some accounts there are included life history notes the relevancy of which often is not clear. A bibliography of 152 titles brings together most of the recent American papers on biogeography. There is an index of four pages, listing only biogeographic units.

As one reads the accounts, an excessive amount of arbitrariness becomes evident. Thus, the eastern part of the aspen parkland, in south-central Canada, is "properly [!] included in [the "Illinoian"] province and [in the west] . . . divided between the Hudsonian and Saskatchewan provinces" (p. 12). What is accomplished by this splitting of a biotic community, the unity of which Dice recognizes when he states that it "seems . . . not to be of sufficient importance to constitute a separate biotic province"? Again, on page 32, "isolated patches of humid redwood forest occur along the Californian coast south of San Francisco, but these patches are not considered to be a part of the Oregonian province," which includes the north-coast redwoods. The fauna of these patches is related to that of more northern redwood areas. Should any biogeographic classification deny a fact such as this?

Dice's own brief contrast of the biotic province and the biome makes a further elaboration of the differences worthwhile. As he states, a biome is "coincident with its climaxes" (p. 4). Thus, isolated areas of coniferous forest in several of Dice's western biotic provinces may be considered to be parts of one biome. Geographic discontinuity is a feature of several western biomes. "A biotic province, on the contrary, is never discontinuous" (p. 4). This claim does not seem to me to argue in favor of biotic provinces. The very discontinuity of the major communities is of fundamental significance in faunistics. Moreover, the continuity of biotic provinces is more apparent than real and can be reduced to a mere matter of map drawing, for the ecological units within one of Dice's geographic blocks can hardly be said to be continuous. For example, the associations and life belts in the mountainous region called the "Coloradan" province are certainly chopped up; several climaxes (or biomes) are present. The "Hudsonian" province, however, is relatively continuous; but one climax, the transcontinental coniferous forest, is present.

Thus, a fundamental difference between the two systems emerges. A biotic province may include one to six different important climaxes

(or one to six different biomes, as each vegetational climax formation is the basis of one biome). Moreover, many of these climaxes recur in several biotic provinces. The biota of the coniferous forest displays fundamental similarity in the "Coloradan," the "Montanian," the "Hudsonian," as well as other provinces. But Dice's system obscures this; there is no clue that the "Hudsonian" is more closely related to the "Montanian" and "Coloradan" than it is to the "Saskatchewan" and "Kansan" (both primarily grassland). There are, therefore, certain hierarchical relations between the biotic provinces as well as between subdivisions of several provinces which are not at all apparent. Moreover, Dice states (p. 5) that the "classification of biotic provinces . . . is based to a very large extent on the vegetation. . . . The vegetation accordingly offers for the present the most satisfactory basis for distinguishing the major ecologic communities of the continent." If this is so, why could not the relations of the vegetational climaxes be emphasized more? The life belts of one western biotic province are most closely related to corresponding life belts in a neighboring province. Yet the life belts are made subordinate to the biotic province. How does Professor Dice reconcile this feature of his system with his recognition of the fundamental significance of vegetation?

No extended critical analysis of biotic provinces is possible from a study of this book. The discussion of the theoretical bases for the units of Dice's system is inadequate, and in the accounts of provinces not enough is explained of the author's reasons for his decisions. There are no qualitative analyses of the mammalian fauna of each province such as were presented earlier for the "Canadian" and "Sonoran" biotic provinces (Ecol., 19, 1938:503-514 and 20, 1939:118-129, respectively). Perhaps this was the author's intention; lack of adequate data and other circumstances may have prevented him from preparing more detailed accounts of his provinces. But Professor Dice's field experience apparently has been extensive, and, emphasizing that "any biogeographic classification must be in part arbitrary," he wisely offers his classification "frankly as an experiment" (p. 7). Tacitly, then, ecologists and zoögeographers are invited to test this classification. Dice's book serves to re-focus attention on numerous problems in the vast field of biogeography, and my comments are offered in the same spirit of cooperative investigation.—FRANK A. PITELKA.

MINUTES OF COOPER CLUB MEETINGS

SOUTHERN DIVISION

JUNE.—The regular monthly meeting of the Southern Division of the Cooper Ornithological Club was held Tuesday, June 29, 1943, at 8:00 p.m. in Room 145, Allan Hancock Foundation, Los Angeles, with President I. D. Nokes in the chair.

Minutes of the May meeting were approved and applications for membership were read from Mr. M. B. Cater, P.O. Box 4247, Univiersity Station, Tucson, Arizona, proposed by John McB. Robertson; and from Mr. F. T. Maddocks, Division of Highways, 3435 Sierra Way, Sacramento, California, proposed by Mrs. N. Edward Ayer. A letter was read from Harvey I. Fisher announcing the anniversary edition of the Condor. A motion was carried that Mr. Howard Robertson be elected to honorary membership.

Field observations were reported by Miss Frances L. Cramer, Lieut. Kenneth E. Stager and H. P. Davis.

The address of the evening was given by Dr. Hildegarde Howard on the subject of "New Mounts of Old Birds." Illustrated by slides, the talk described restorations of fossil birds of the southwestern states and particularly those from the local Rancho La Brea asphalt pits.

Adjourned.—WALTER W. BENNETT, *Secretary*.

NORTHERN DIVISION

JUNE.—The regular monthly meeting of the Northern Division of the Cooper Ornithological Club was held on Thursday, June 24, 1943, at 8:00 p.m., in Room 2503, Life Sciences Building, University of California, Berkeley, with President Robert C. Miller in the chair and about 130 members and guests present. Minutes of the Northern Division for May were approved as read. There were two proposals for regular membership in the Club: William E. Douglas, Tulelake Ranger Station, Tulelake, California, by H. W. Carriger; P. Quentin Tomich, 2315 Dwight Way, Berkeley 4, California, by Jean M. Linsdale. A special proposal was read nominating Howard Robertson, President of the Board of Directors, to honorary membership in the Club, in recognition of his long service to the organization.

R. C. Miller mentioned the publication of a recent volume by David Lack on the natural history, habits and behavior of the English Robin.

The president called upon Mrs. Joseph Grinnell to give a brief history of the club, as this meeting marked the fiftieth anniversary of its founding on June 22, 1893.

A program appropriate to the occasion was furnished by Mrs. T. Eric Reynolds in the form of Kodachrome motion pictures entitled "Added Fun with Birds." Outstanding was a new sequence on a nesting colony of Caspian Terns near Alvarado, California.

Adjourned.—FRANCES CARTER, *Recording Secretary*.

ANNOUNCEMENT OF POSITION

The location of war industries and the numerous war restrictions have retarded and handicapped efforts in the past two years to establish a biological laboratory and research station that would also be the repository of the Bailey collections and library. Accordingly, another excellent and natural site was purchased last summer: the old and well known (though deteriorated) Rockbridge-Alum Springs property, comprising some 1516 acres of meadow, woodland, mountain stream, pure water springs, and the famous medicinal springs.

The acreage is in the mountains of Virginia, at 2000 feet altitude, and is approximately three-fourths surrounded by the George Washington-Jefferson National Forests. It is 18 miles from either Lexington or Clifton Forge, and 6 miles and 9 miles, respectively, from Millboro and Goshen on the main line of the Chesapeake and Ohio Railroad. Reconstruction of several of the old brick buildings has been completed, and we are going ahead with such work as can be carried on, looking forward to the future successful establishment of our project.

We now want, and need, some man interested in natural history, married and not subject to draft, who will live on our place and cooperate with us in making it a wildlife preserve. There will be a salary, living quarters, and other perquisites for any one who joins us. Do not apply unless you have a keen and sincere interest in natural history.

HAROLD H. and LAURA L. BAILEY
Route 2, Goshen
Virginia

For Sale, Exchange and Want Column.—Each Cooper Club member is entitled to one advertising notice in any issue of The Condor free. Notices of over ten lines will be charged for at the rate of 15 cents per line. For this department, address JOHN MCB. ROBERTSON, Buena Park, California.

FOR SALE AT A GREAT SACRIFICE—"Illustrations of the Nests and Eggs of the Birds of Ohio with text"; illustrations by Mrs. N. E. Jones, text by H. Jones; 2 vols. folio, 1879-86. This work is one of the rarest of American ornithologica; only 90 copies were issued, and it has been favorably compared to Audubon's works. Have a set of this rare book and will be glad to quote prices to interested parties.—MRS. L. H. MEARNS, *313 South Court St., Circleville, Ohio.*

FOR SALE—The Condor, unbound, complete volumes, nos. 18, 21, 23, 24, 25, 26, 27, 43, and 44. Incomplete volumes, with following numbers missing: 19, no. 4; 22, no. 6; 28, no. 1; 42, no. 1; 20, nos. 1 and 4; 17, nos. 1, 2 and 3; 41, nos, 1, 2 and 3. $1.25 per complete volume, $ .25 a single copy.—MRS. FRIEDA ABERNATHY, *Apt. 35, 2419 Durant Ave., Berkeley, California.*

FOR SALE—Ridgway's "Birds of North and Middle America," nine volumes; vols. 1 to 8 inclusive in original green government binding, and vol. 9 unbound. This is a rare set and in excellent second hand condition. $40.00 post paid. Also Bent's "Life Histories of North American Birds," 14 volumes, complete in original covers as issued, in perfect second hand condition, and mostly autographed by the author. $85.00 post paid. A few extra volumes of Bent's Life Histories, with autograph letters inserted. All original covers.—W. LEE CHAMBERS, *Robinson Road, Topanga, California.*

FOR SALE—My 20-guage Fox Sterlingworth with fitted 38 aux. All tools, shells and case. Best of condition and best all round specimen equipment that can be assembled. $44.00 prepaid.—F. M. DILLE, *Nogales, Arizona.*

FOR SALE—Bent's "Life Histories of North American Birds": no. 142, $3.00; no. 146, $3.00; no. 162, $5.00; no. 176, $2.00; no. 179, $1.00. Miller's "Families and Genera of Bats," Bull. 57, U. S. Nat. Mus., $1.00; Gross's "The Heath Hen," Mem. Boston Soc. Nat. Hist., $2.00; N. A. Faunas, nos. 5 (lacks covers), 8, 38, 57, the lot, $3.50. Have many odd numbers: "Osprey," both old and new series (no no. 7); long runs of "Condor" and "Natural History"; details and prices on request.—LAURENCE M. HUEY, *Natural History Museum, Balboa Park, San Diego, California.*

FOR EXCHANGE—Anderson's "Birds of Iowa" (new copy), Bailey's "Birds of New Mexico" (new copy), Pearson and Brimley's "Birds of North Carolina" (new copy), Krider's "Forty Years Notes of a Field Ornithologist," Widmann's "Birds of Missouri," a set of Bent's "Life Histories" (lacks Diving Birds). WANTED—A set of Seton's "Lives of Game Animals" (8 vols.); also early issues of The Auk and other bird magazines, and these issues of The Oologist: vol. 14, nos. 10, 11, 12; vol. 15, no. 1; vol. 16, no. 9.—F. J. PIERCE, *Winthrop, Iowa.*